IDENTIFICATION OF THE DECEASED: A RETROSPECTIVE REVIEW OF FORENSIC ANTHROPOLOGY CAPE TOWN CASEWORK

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ABSTRACT

A serious issue faced in South Africa is the identification of unknown persons, particularly those who are decomposed, skeletonised or burnt. In this regard, Forensic Anthropology Cape Town (FACT), a service provider at the University of Cape Town (UCT), has assisted with identification. Data pertaining to anthropologically analysed cases in the Western Cape (WC) province is lacking and little is known about the contribution FACT has made to local forensic investigations. Thus, this study sought to identify the profile of FACT cases and evaluate their impact on police case resolution and identification. Cases referred to FACT between 2006 – 2018 from Forensic Pathology Services (FPS) were retrospectively reviewed (n = 208). Univariate, bivariate and multivariate statistical analyses were performed to find patterns in the data. Of these, 172 were of forensic relevance. There was a predominance of men (67%), and adults older than 35 years (54%). Regarding ancestry, 37% of decedents were of Mixed ancestry, 22% were of African ancestry and 3% were of European ancestry. Ante- and peri-mortem injuries were observed in 41% and 29% of decedents, respectively. Most decedents (51%) were discovered in high crime police precincts; however, a significant number were also found in low crime sparsely populated areas (47%), popular for recreational activities. These findings highlighted common areas for the discovery of decomposed bodies that may guide future forensic taphonomic research to better understand local decomposition rates. Positive identifications were reached for 37% of decedents, and of these, anthropological estimations were correct in 98% cases for sex, 84% for age-at-death, 80% for ancestry and 100% for stature. Communication issues between relevant stakeholders, the discretion of the authorities (when FACT would be consulted) and the availability of FACT members or resources (*e.g.,* transport for the body to FACT laboratory) were among the main factors impacting FACT consultations and analysis; indicating that the legislation of forensic anthropology in South Africa is needed. Nevertheless, where identifications were subsequently made, the demographic estimations showed a high level of accuracy, suggesting that the anthropological techniques employed by FACT perform well in local forensic casework and FACT is assisting with social and criminal justice.

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LIST OF ABBREVIATIONS

AAFS: American Academy of Forensic Sciences

ABFA: American Board of Forensic Anthropology

ASSA: Anatomical Society of Southern Africa

CEMEL: Centro de Medicina Legal

DNA: Deoxyribonucleic acid

EAAF: *Equipo Argentino de Antropología Forense*

FACT: Forensic Anthropology Cape Town

FAIG: Forensic Anthropology Interest Group

FARC: Forensic Anthropology Research Centre

FPS: Forensic Pathology Services

HVIRU: Human Variation and Identification Research Unit

HWC: Heritage Western Cape

LABANOF: Laboratorio di Antropologia ed Odontologia Forense

NGO: Non-government organisations

PMI: Post-mortem interval

SAHRA: South African Heritage Resource Agency

SAPS: South African Police Service

SMLC: Sheffield Medico-Legal Center

SRM: Salt River Mortuary

TRC: Truth and Reconciliation Commission

UCT: University of Cape Town

USA: United States of America

VIC: Victim Identification Centre

ViSUN: Victim Identification @ Stellenbosch University unit

WC: Western Cape

INTRODUCTION

The identification of deceased persons is of great importance for criminal, social, humanitarian, ethical and civil reasons (Krysztofiak, 2017). In South Africa many decedents remain unidentified, due to the overwhelming number of cases faced by authorities; migratory flows of people, both internally and from other countries (legally or illegally); the lack of ante-mortem dental and medical records; and post-mortem changes such as decomposition or burning (Naidoo, 2007; Evert, 2012). In cases involving highly decomposed or burnt remains, forensic anthropologists, as experts in anthropology, osteology and skeletal anatomy, can be relied on to assist with identification (İşcan, 1988).

Currently, studies examining the contributions of forensic anthropologists in human identification in forensic casework are limited, with most having been conducted in developed countries. These studies, which will be discussed in greater detail later in this chapter, provided valuable information regarding the number of anthropologically analysed decedents. This included the populations most at risk of being unidentified, the sites where most bodies were recovered and the rates of positive identifications and accuracy of estimated biological profiles. These data are useful in developing intervention strategies to reduce deaths among populations most at risk of having a compromised identity as well as identifying disposal hotspots for the discovery of remains so they can be monitored and utilised for forensic taphonomic research. Ultimately, this improves the rates of identification of unknown decedents and precision of demographic estimations in casework. While the results from some of these studies were generally comparable (for example, the decedents were predominantly male), some were inconsistent (*e.g.*, ancestral compositions, preservation of the remains or trauma observed). The disparities were suggested to be due to differences in regional demographics, murder rates, environmental conditions and/or socioeconomics (Evison *et al.* 2012) thus, highlighting the importance of regional-specific research.

Three studies evaluating forensic anthropology laboratories have been conducted in South Africa, with two being at the Forensic Anthropology Research Centre (FARC) laboratory at the University of Pretoria (Steyn *et al.* 1997; Steyn *et al.* 2016). The studies situated at FARC primarily reported their caseloads and provided a description of demographic profiles of the cases. However, data regarding positive identifications or accuracy of demographic profiles was minimal or entirely absent.

The third study examined cases received by Forensic Anthropology Cape Town (FACT) laboratory, Cape Town, in the Western Cape (WC) province (Baliso *et al.* 2019). This study provided baseline data for anthropologically analysed cases in Cape Town, presenting the patterns of cases and the frequencies of the police case resolutions, positive identifications and accuracy rates of the estimated biological profiles in anthropological casework. This study, however, had several limitations. First, it was not representative of all FACT's cases as only a subset of anthropological reports were evaluated in the pilot study. Additionally, the significance or robustness of the results and conclusions were reduced due to lacking information regarding case outcomes, positive identifications and decedent ante-mortem records (used to determine the accuracy rates of FACT demographic estimations).

The purpose of this research is to expand on the pilot study and examine all of FACT's cases referred from Forensic Pathology Services (FPS) in the WC province. The results of this study are intended to contribute towards improving the rates of identification of unknown decedents and ultimately reducing the burden on forensic mortuaries as well as provide answers that may assist in the grieving family's closure process; identifying local case patterns to facilitate forensic anthropological research and teaching that reflects caseloads; and ultimately motivate for the formalisation of forensic anthropology in the country.

The following literature review describes the extent that unidentified remains are an issue both locally and globally, the consequences of their burden and suggests the possible reasons for their persistence in the local context. This will be followed by a description of the process of identification in South Africa, focusing on remains subject to anthropological analysis. Subsequently, the role of forensic anthropologists in the South African medico-legal system is outlined, focusing on the WC province, alongside the roles of the relevant stakeholders (the South African Police Service (SAPS) and FPS). Thereafter, the research aims, and objectives are provided.

1.1 IDENTIFICATION OF DECEASED PERSONS

1.1.1 The importance of identifying deceased persons

The inability to accurately identify decedents has numerous consequences for the deceased person, their loved ones and society. An unidentified person in a medico-legal facility is a missing person for a family. A known death, however painful, at the very least leads to some form of closure, instead of the emotional anguish experienced when there is uncertainty of the

fate of a loved one (Truth and Reconciliation Commission Report, 2003). Moreover, there are legal consequences for families in cases when a loved one is missing but death cannot be confirmed, including an inability to transfer assets to the deceased's beneficiaries, disband a marriage and claim insurance money (Evert, 2012; Krysztofiak, 2017).

Lack of identification also has consequences for the unidentified person themselves. In South Africa, unidentified bodies are buried *en masse*, with three or four stacked in a single grave or they are cremated, with no one there to mourn them (Naidoo, 2007; Evert, 2012). Additionally, unidentified bodies become the property of the state after 30 days and can be donated to specified institutions to be used for research and teaching purposes (The National Health Act 61 of 2003), presenting an ethical dilemma. Unidentified bodies have been used in the commission of life insurance fraud, where false life insurance policies are claimed by substituting the identity of a deceased individual for that of a life insured living person. These syndicates sometimes rent out or sell unidentified bodies amongst each other to commit multiple cases of fraud (Association for Savings and Investment South Africa, 2018).

The inability to identify decedents negatively affects not only the individuals and their families but it has a broader significance for criminal justice and medico-legal facilities. Without an identification it is unlikely for anyone criminally responsible for a death to be prosecuted (Krysztofiak, 2017). This can be attributed to the challenges associated with establishing the motive behind the criminal act or obtaining witnesses or suspects (Krysztofiak, 2017).

In some medico-legal facilities the prolonged storage of unidentified bodies poses a serious health hazard to staff by exposing them to diseases (Kubheka, 2019). Due to the large volumes of unidentified bodies entering the medico-legal facilities, they often run out of space in cold storage and bodies pile up on floors, slowly putrefying before they can be autopsied (Makhubu, 2012). In addition, while awaiting pauper burial arrangements and approvals from the city, unidentified bodies have to be kept in the facility, further increasing the number of bodies having to be stored (Mukhuthu, 2015).

1.1.2 The burden of unidentified persons

The inability to identify unknown decedents is an issue experienced globally, varying greatly between countries. Studies have shown that developing countries such as India and South Africa generally have higher incidences of unidentified bodies than developed countries.

(Table 1.1). These disparities are possibly associated with socioeconomic statuses, population densities and mortality rates (Yadav *et al.* 2016; Reid *et al.* 2020).

Table 1.1 Studies showing the rates of unidentified bodies in casework.

Author	**Year of study (Study period)**	**Study site**	**Country**	**Rate of unidentified bodies**
Cattaneo *et al.*	2010 (1995–2008)	Institute of Legal Medicine, LABANOF (Laboratorio di Antropologia ed Odontologia Forense)	Italy	3% of 14 607 autopsies
Hanzlick and Smith	2006 (May 10, 2003, and May 9, 2004)	Fulton County Medical Examiner	United States of America (USA)	0.04% of 2 279 cases
Paulozzi *et al.*	2008 (1979 – 2004)	Centers for Disease Control and Prevention's and National Center for Health Statistics	USA	413 each year, at a rate of 16.1 per 10 million people
Cavard *et al.*	2010 (2003–2009)	Department of Forensic Medicine and Pathology (University Hospital R. Poincare´, Garches	France	9% of 2 384 cases
Kumar *et al.*	2014 (five years)	Department of Forensic Medicine & Toxicology, Government Medical College & Hospital, Chandigarh	India	4% of 3 165 cases
Chattopadhyay *et al.*	2013 (2010 – 2011)	Calcutta Police Morgue attached to the Department of Forensic Medicine, Medical College, Calcutta	India	25% of 2 515 cases
Yadav *et al.*	2016 (2010–2014)	Department of Forensic Medicine and Toxicology, New Delhi	India	16% of 7 964 cases
Evert	2012 (2005 – 2008)	Medico-legal facility in Pretoria	South Africa	Average between 7% and 10% (range, 154 – 250)
Lerer and Kruger	1998 (1980 and 1995)	Salt River Mortuary (SRM), Cape Town	South Africa	3% of total admissions, an average 137 (range, 75 – 280)
Reid *et al.*	2020 (2010 – 2017)	SRM, in Cape Town	South Africa	About 9% of total autopsies (310 per annum p.a.)

1.1.3 Process of human identification in South Africa

Prior to exploring the possible reasons why decedents may remain unidentified, this section identifies some of the key stakeholders involved in the identification of deceased persons in South Africa and describes the different roles they play. This is because the description of the challenges associated with identification of unknown decedents in the next section is based on the knowledge of the process of identification or the stakeholders involved.

In South Africa, the founding law governing the performance of post-mortem investigations in unnatural deaths is the Inquest Act 58 of 1959. The Inquests Act mandates that an

investigation be opened to determine the identity, cause-of-death and if anyone is criminally responsible for the death of the decedent (Inquests Act 58 of 1959). Identification falls within the mandate of the SAPS and is assisted by FPS (The National Health Act 61 of 2003). The SAPS form a part of the Department of Police and is a national agency.

To identify unknown decedents, the police will search their fingerprints against the local and subsequently, the national criminal records database in the Local Criminal Record Centre (Krysztofiak, 2017). If that yields no results, the police will search for the decedent's fingerprints in the Department of Home Affairs fingerprint database (Krysztofiak, 2017). The Victim Identification Centre (VIC), a specialised unit, assists with identification by obtaining fingerprints of the decedent; collecting DNA from the belongings of missing individuals or their direct relatives; recovering and examining human remains; and producing two-dimensional and/or three-dimensional facial reconstructions for dissemination. The SAPS's Forensic Science Laboratory will compare the ante- and post-mortem DNA samples collected from the deceased and their families (Smith, 2020).

The FPS was established in 2006 when all government forensic medico-legal facilities were transferred from the SAPS to the Department of Health. FPS's mandate is to investigate all unnatural deaths, primarily, to determine the cause-of-death. They also assist with identification by attempting to contact the decedent's next of kin at the scene, as well as by facilitating identification at the facility via visual identification of the body or images. In addition, fingerprints, facial images, biological and distinguishing features, blood and tissue samples (for DNA analysis), post-mortem radiographic examination and personal items are captured or obtained to assist the police with the identification. While the identification of most decedents is possible through conventional methods (*e.g.*, fingerprints, visual identification), when the remains are physically unidentifiable (*i.e.*, highly decomposed, burnt or mutilated) they are often referred to forensic anthropology laboratories, at the discretion of forensic pathologists or law enforcement (Morris, 2011; Krüger *et al.* 2018; Baliso *et al.* 2019; Smith, 2020).

Forensic anthropologists are often requested to reconstruct the demographic profile (sex, age-at-death, ancestry, stature) of a decedent from their skeleton; interpret the aetiology of traumatic injuries and pathological conditions; identifying other individualising features; and interpreting taphonomic changes to estimate the post-mortem interval (PMI) (Steyn *et al.* 1997; L' Abbé and Steyn, 2012; Steyn *et al.* 2016; Baliso *et al.* 2019; Smith, 2020). The information

anthropologists provide is used by the police to search through reports of missing persons and ultimately, narrow down the number of potential people who could be the individual.

1.1.4 Challenges with identification of unknown decedents in South Africa

The potential reasons an individual may remain unidentified is multifaceted. One factor could be the high mortality rate in the country. In 2006, a total of 614 248 deaths were recorded and this gradually subsided to 456 612 in 2016 (Statistics South Africa, 2016). The high mortality rate has been attributed to diseases (Pillay-van Wyk *et al.* 2016; Statistics South Africa, 2016); high rates of motor vehicle accidents (Norman *et al.* 2007; Kriegler and Shaw, 2015); suicides (Norman *et al.* 2007); fire related deaths (Niekerk *et al.* 2006; Kimemia and Van Niekerk, 2017); and homicides (Norman *et al.* 2007). In 2016, non-communicable diseases accounted for 57% of deaths, while communicable diseases and injuries accounted for 31% and 11% of deaths respectively.

South Africa has one of the highest murder rates in the world (WC Provincial Crime Analysis Report, 2017). With an estimated population of only 56 million people (Statistics South Africa, 2019) and 19 016 murders recorded in 2016/17, the country's murder rate was ranked fifth highest in the world, five times more than the global rate of 6.1 murders per 100 000 people (WC Provincial Crime Analysis Report, 2017). The WC province is considered the country's murder centre, with more than 3 000 murders reported annually in the past five years (Crimestatssa.com, 2020). The WC province has the third largest populace in the country, with an estimated 6.4 million people in 2017, bringing the murder rate to approximately 52 per 100 000 people – eight times more than the global rate (WC Provincial Crime Analysis Report, 2017). The sheer volume of bodies means government agencies are usually faced with excessive caseloads and backlogs, struggling to resolve the large numbers of unidentified remains cases, especially those of highly decomposed or burnt remains.

Also contributing to the unidentified bodies in the country could be the large numbers of cross-border migrants. According to Statistics South Africa's last official census in 2011, the number of foreign nationals was determined to be around 2.2 million. Every year thousands of illegal immigrants are arrested and deported (Parliamentary Monitoring Group, 2019), indicating that the number of migrants unlawfully in the country is substantial. Since foreign nationals live within South Africa, they also contribute to the country's mortality rate and have been suggested to represent a significant proportion of unidentified persons (Bax, 2018).

Identification of foreign nationals can be challenging for several reasons, including a lack of ante-mortem medical or dental records and families often being reluctant to report the missing individual in fear of deportation or persecution (Anderson, 2008; Kiepal *et al.* 2012).

South Africa has a large number of circular labour migrants who may also present with unique challenges when it comes to identification. These individuals frequently travel from under-developed rural areas to urban areas in search of employment, leaving their families behind (Posel, 2004). They often settle in overcrowded informal settlements surrounding the urban areas where they are exposed to poverty, diseases and violent crime, resulting in a high mortality rate in this population. Their families are usually not privy to their daily whereabouts as they often only return home intermittently throughout the year (Posel, 2004; Kok *et al.* 2006). Moreover, due to their oscillatory movements, they tend to have loose ties in the urban settlements they reside in (Posel, 2004; Schiel 2014). Consequently, should they disappear, it may take a while before anyone notices and reports them missing. As a result, prolonged post-mortem discoveries may be common in this population, where post-mortem changes such as decomposition or skeletonisation have occurred. Therefore, their identification can be difficult because of challenges experienced when extracting useable DNA from post-mortem samples (Iwamura *et al.* 2004; Zgonjanin *et al.* 2018; Longden-Thurgood, 2018); or the inability to obtain comparable samples because the decedent's family cannot be located.

Being in touch with families is useful for investigators in that they can provide ante-mortem descriptions about unique individualising features and comparable DNA samples to match with post-mortem samples/features of the unknown individual. Ante-mortem descriptions of skeletal features unique to the individual (*e.g.,* ante-mortem fractures or number of teeth present, patterns of displaced teeth or unusual rotation) from families can be especially important when there is a lack of conventional identifiers (such as fingerprints) or ante-mortem medical records of decedents (*e.g.*, dental records) (Ubelaker, 2008). Fingerprint identification is often impossible because of lack of identity documents (Venter, 2018). Most South Africans do not prioritise, have access to or cannot afford dental services, and therefore, will seldom have any ante-mortem dental records for comparison (Naidoo, 2007; Evert, 2012).

Further impeding identification are the challenges faced by law enforcement and other government agencies involved in death investigations. They are wholly understaffed, and lack financial, functional and infrastructural resources (Evert, 2012; Reid *et al.* 2020). The police have been criticised for not properly investigating cases involving missing and unidentified persons (Lerer & Kugel, 1998; Emser and van der Watt, 2019). The FPS are not well funded

either and are faced with similar challenges to the SAPS. Since they are under the Department of Health, they have to compete for funding with other health services, unfortunately, deceased persons are not as prioritised as living patients (Bax, 2018). Identification is also hindered by the poor communication between stakeholders (Baliso *et al.* 2019; Smith, 2020). Moreover, the personnel who are available in government agencies are usually not well trained, especially in advanced human identification methods (L'Abbé and Steyn, 2012). In these instances, forensic anthropologists are relied on to assist with identification. The next section outlines the development of forensic anthropology, the current status of the field and provides retrospective reviews that have highlighted the contributions of forensic anthropologists in casework.

1.2 THE ROLE OF FORENSIC ANTHROPOLOGY IN HUMAN IDENTIFICATION

The establishment of forensic anthropology extends back to European centres of comparative anatomy and was furthered by testimonies of prominent American scholars in high profile murder trials and the creation of documented skeletal collections. These brought about widespread recognition of consultation of experts in casework and facilitated the development of anthropological methodology and techniques necessary for the acceptance of anthropological methods in the legal arena. The establishment of the anthropology section of the American Academy of Forensic Sciences (AAFS) in 1972, the American Board of Forensic Anthropology (ABFA) in 1979 and other similar organisations worldwide was critical for the credibility of practitioners as they provided certifications and meaningful credentials. Further advancements in the field can also be attributed to the invaluable contributions that forensic anthropologists have had in locating, recovering, analysing and identifying the remains of victims of war (Šlaus *et al.* 2007; Borić *et al.* 2011), genocide (Morgan, 2011; Tyers, 2009; Ubelaker, 2018) and mass disasters (Blau and Briggs, 2011).

Currently, the role of forensic anthropologists varies by country due to differing legal systems, available training, education and employment opportunities (Obertová *et al.* 2019). In some countries, mainly those that are developed, forensic anthropologists are certified and recognised professionals (Ubelaker, 2018; Obertová *et al.* 2019); employed either in the medical examiner's office as official full-time consultants to law enforcement or departments of forensic medicine or as part of universities or laboratories that are consulted by law enforcement. They actively participate in crime scene recovery, examination of the remains and they write forensic reports (İşcan and Olivera, 2000; Komar and Buikstra, 2008; Kranioti

and Paine, 2011; Obertová *et al.* 2019). In other countries, mostly developing, forensic anthropologists are based in academic institutions, primarily involved in research and training of students and sporadically being consulted by the police or medical examiners (Ubelaker, 2018; Obertová *et al.* 2019).

In South Africa, historical advances of the field have followed international trends, undergoing considerable evolution within the discipline of physical anthropology. Skeletal collections were also assembled in universities across the country, resulting in a marked amount of research to perform validation studies of existing anthropological methodology and most importantly, the development of population-specific methods (L' Abbé and Steyn 2012; Krüger *et al.* 2018). The need for modern, population-specific anthropological methodology in South Africa is due to the challenges experienced when methodology developed in non-South African populations are applied to the local population (Simmons and Haglund, 2005; L' Abbé and Steyn, 2012; Krüger *et al.* 2018).

The use of methods developed in other non-South African populations to estimate age-at-death using the third molar could overestimate the age-at-death of an individual of African ancestry since it erupts much earlier in this population (Olze *et al.* 2007; Esan and Schepartz, 2018). In terms of sex estimations, the need for population-specific methodology could be due to sexual dimorphism being demonstrated to be lower for South Africans, compared with North Americans (L'Abbé *et al.* 2013; Krüger *et al.* 2015). Further limitations associated with previous studies on sexual dimorphism in South Africans include a lack of standards for other local population groups that are not black or white South Africans (Krüger *et al.* 2018). The heterogeneous nature of the South African population also makes it difficult to apply ancestry estimation methods developed from in other countries. The South African population constitutes a myriad of biological and cultural variation, due to people of different geographical backgrounds who willingly migrated or were forcefully brought into the country (Krüger *et al.* 2018).

The status of forensic anthropologists and their possible contributions to human identification became more recognised after the abolishment of apartheid in 1994, with the investigation of the disappearances of many individuals during that era. For the purpose of the identification and repatriation of these individuals, forensic anthropologists from the University of Cape Town (UCT), the Universities of Pretoria and Witwatersrand, along with the Argentine NGO Forensic Team known as the *Equipo Argentino de Antropología Forense* (Morris, 2014) were gathered. South African anthropologists have continued to be instrumental

in investigations of historical cases, aiding in the identification, repatriation, restitution and reburials (Nienaber and Steyn 2002; Larsen and Walker, 2005; Morris, 2014; Smith, 2015).

Despite the long history of aiding in casework, the participation in human rights efforts and the considerable volume of research that has been produced; the field still faces significant practical challenges in South Africa. Since organisations similar to the American Board of Forensic Anthropology or Forensic Anthropology Society of Europe have not been established in the country, there are currently no clear guidelines, minimum qualification requirements or specific accreditation in place for one to practice as a forensic anthropologist or to determine their level of expertise. In 2013, the Forensic Anthropology Interest Group (FAIG) was established within the Anatomical Society of Southern Africa (ASSA) in an attempt to address these issues, without any success (L' Abbé and Steyn, 2012). Forensic anthropology is not formalised or legislated as part of medico-legal investigations involving decomposed, skeletonised or burnt cases. It is the prerogative of forensic pathologists or the police to consult anthropologists for cases (Baliso *et al.* 2019; Smith, 2020). Furthermore, there are no standards for the admissibility of anthropological evidence in South African courts of law (L' Abbé and Steyn, 2012).

South African forensic anthropologists are employed in academic institutions, as part of research units or laboratories. Currently, these include FARC at the University of Pretoria established in 2008 (L' Abbé and Steyn, 2012); FACT at UCT formalised in 2014 (Baliso *et al.* 2019); the Human Variation and Identification Research Unit (HVIRU) established at the University of the Witwatersrand in 2016 (L' Abbé and Steyn, 2012) and Victim Identification @ Stellenbosch University unit (ViSUN), WC province (Smith, 2020).

1.2.1 Forensic Anthropology Cape Town

Academics and senior post-graduate students at UCT have a long history of assisting government agencies in forensic cases. These agencies include the SAPS, VIC, FPS, Heritage Western Cape (HWC), South African Heritage Resource Agency (SAHRA) and other private agencies and/or individuals (such as attorneys, family members or private companies) (Gordon & Drennan, 1948; Baliso *et al.* 2019). Consultations occurred on an informal basis, until 2014, when FACT was formalised, as a result of the increase in the use of the service since 2005. Referrals are at the discretion of the other agencies, and FACT examinations are at each

member's personal capacity. As a result, consultations are infrequent and often delayed (Baliso *et al.* 2019).

Most FACT consultations are from the FPS (and, subsequently, the SAPS) and are of medico-legal significance. Cases referred to FACT are generally, but not limited to those involving decomposed, skeletonised or burnt remains. Less frequently, cases are referred for radiological analyses. Primarily, FACT will examine the remains to determine a biological profile of the individual, for individualising features, pathological conditions and trauma. On rare occasions, FACT will be requested to analyse or interpret the traumatic injuries sustained on an already identified in decedent (Baliso *et al.* 2019).

Generally, the anthropological examination of the remains occurs at the FPS facility in the presence of a forensic pathologist if the remains are decomposed but have substantial soft tissue present. Occasionally, examination will occur at the FACT laboratory at UCT if the remains are completely skeletonised. Post-examination, an affidavit will be provided to the relevant stakeholders. When consulted by the FPS, the forensic pathologists will usually incorporate the information on the FACT affidavit into their own affidavit or they attach a copy of it to their affidavit. Post-submission of the report, there is rarely any communication or feedback to FACT regarding case resolution or positive identification (Baliso *et al.* 2019). Therefore, despite having assisted in many cases over the years, little is known about the contribution FACT has made to local death investigations.

Recently, a study by Baliso *et al.* (2019) provided statistical evidence of the contribution FACT has made to death investigation at a single mortuary in the Western metropole of the City of Cape Town. The results of this study are summarised below, along with a review of similar studies conducted globally and nationally (Table 1.2), to demonstrate the value such research can add to the discipline of forensic anthropology. While certain patterns in these studies were generally comparable, for example age and sex bias generally being toward younger to middle-aged adults and men respectively; marked differences were observed in terms of frequency of caseloads, ancestral composition of the populations represented, frequencies and mechanisms of trauma, taphonomic changes and geographical distribution of discoveries. The differences were attributed to factors relating to regional socio-economic status, differing natural environments, demographics, as well as crime and homicide rates. Additionally, there were inconsistencies and variations with the parameters or variables evaluated in these studies, creating disparities in the results that were observed.

The studies that examined the precision of estimated demographic profiles showed high accuracy rates. However, these cannot be considered as representative or predictive of how anthropological methods perform in casework in general because anthropological methods employed in casework in different laboratories are not similar/standardised. In addition, the applicability of anthropological methods in American populations is more certain since most anthropological methods utilised in casework were developed in American populations. However, there have been issues with the applications of anthropological methods outside of the reference population (Ubelaker, 2008). Furthermore, the estimation of demographic variables is also dependent on the preservation of the skeleton (taphonomy, completeness or fragmentation), the practitioner's education level and observation error or their use of the anthropological instruments.

While the studies that have been conducted in South Africa have provided valuable information, they have had some limitations. The studies conducted at the FARC did not assess case outcomes, positive identifications or the accuracy of the methods utilised in casework. Similarly, the study at FACT only evaluated a subset of case reports, providing only a partial view of FACT caseload as well as impact. Additionally, the information available for the evaluation of contribution to case resolution (*i.e.,* case outcomes, positive identifications or ante-mortem records of the identified decedents) was insufficient. Therefore, the conclusions made regarding impact of forensic anthropological analyses in casework may not be representative of the larger context.

Table 1.2 Studies showing the contributions of forensic anthropologists in casework.

Author	**Year of study (Study period)**	**Study site (Country)**	**Caseload**	**Site of recovery**	**Preservation**	**Demographics**	**Trauma**	**Case outcomes and Rates of Identification**	**Accuracy rates of demographic estimations**
Grisbaum and Ubelaker	2001 (1962 – 1994)	Smithsonian Institution (USA)	500 cases	Recovered mostly exposed or buried outdoors or in water	Mostly incomplete	Predominantly male and white individuals, followed by black, Native American, Asian, and lastly individuals of Black-White admixture	Mostly gunshot wounds, followed by fractures and sharp force		
Komar	2003 (1974 – 2000)	New Mexico Office of the Medical Investigator (USA)	596 cases	Mostly recovered exposed, followed burials and airplane crashes	Most recovered within one week	Predominantly male (76%).	Peri-mortem trauma observed in 58% of cases.		
Parsons	2016 (N/A)	Medical examiners' offices in New York City, Harris County, and Pima County (USA)	204 resolved and 284 unresolved cases						Sex estimations 100% correct; ancestry 99%; age 89%; stature 73%.
Thomas *et al.*	2016 (1974 – 2013)	Federal Bureau of Investigation (FBI) Laboratory, Quantico, VA (USA)	99 cases						Sex estimations were correct in 94.7%.
Thomas *et al.*	2017 (1970 – 2015)	Federal Bureau of Investigation (FBI) Laboratory, Quantico, VA (USA)	360 cases						Ancestry estimations were correct in 90.9%.
İşcan and Olivera	2000 (1991 – 1997)	Laboratorio de Antropologıa Forense at the Morgue Judicial of Montevideo (Uruguay)	189 cases (276 individuals)		Mostly skeletonised; the remainder were decomposed and less frequently, burnt	Predominantly old-aged adults and males.		About a ¼ of individuals positively identified.	

Author	Year of study (Study period)	Study site (Country)	Caseload	Site of recovery	Preservation	Demographics	Trauma	Case outcomes and Rates of Identification	Accuracy rates of demographic estimations
Vaz and Benfica	2008 (1997 – 2006)	Forensic Anthropology Service of the Medical Examiner's Office of Porto Alegre (Brazil)	322 individuals			Predominantly young to middle-aged adults and males.	Mostly fractures and occasionally, firearm projectiles.	26% of individuals positively identified.	
Evison *et al.*	2012 (1995 – 2010)	Sheffield Medico-Legal Center (SMLC), United Kingdom and the Centro de Medicina Legal (CEMEL), Brazil	105 cases (24 at SMLC and 81 CEMEL)	At both centres, bodies were mostly recovered in rural locations or in water		At both centres most were young to middle-aged adult males; individuals at SMLC were entirely White or Indo-European, at CEMEL individuals were mostly black and of mixed ancestry	Frequently observed mechanisms of trauma at CEMEL being gunshot wounds, blunt- and sharp-force	About ½ of cases at SMLC were successfully prosecuted, usually for homicide, at CEMEL outcomes mostly unknown.	
Steyn *et al.*	1997 (1993 – 1995)	Department of Anatomy, University of Pretoria (South Africa)	32 cases (34 individuals)			Predominantly adults, males and individuals of the South African Negroid spectrum	Not common, few observed were gunshot wounds or injuries caused by a sharp object	Three positively identified.	
Steyn *et al.*	2016 (1996 – 2013)	Department of Anatomy, University of Pretoria (South Africa)	Averaged between 30 and 90 per year (768 individuals)	Mostly the veldt	Most in an advanced state of decomposition or skeletonised.	Predominantly adults and males	Mostly ante-mortem injuries. Perimortem injuries less frequent, with blunt-, ballistic- and sharp-force mechanisms being common.		
Baliso *et al.*	2019 (2008 – 2018)	Forensic Anthropology Cape Town (FACT) (South Africa)	73 forensic cases (75 individuals)	Mainly high crime rate areas, remainder found in sparsely populated rural areas.		Predominantly young to middle-aged adult males		47% were positively identified.	Sex, age and stature estimations 100% correct and ancestry 89%.

1.3 RATIONALE

Studies evaluating the contributions of forensic anthropologists have been conducted globally, with most being in the USA (Table 1.2). These studies provided information on the profile and patterns of cases, while others have reported on the accuracy of demographic estimations in actual forensic casework. The parameters examined and results obtained from these studies varied, due to the significant effect local demographics, environment and socioeconomics have on case patterns, making comparisons and discerning trends difficult. Moreover, the high accuracy rates of the demographic estimations observed in previous studies cannot be considered as representative of how anthropological methods perform in casework in general due to the multifaceted nature of these estimations.

Furthermore, while the studies that have been conducted in South Africa have provided valuable information, they have either not examined particular parameters, or the results or conclusions have not been sufficiently robust. Considering the overwhelming burden of unidentified bodies in South African mortuaries and the unique and specific forensic investigation processes and challenges observed in the country, conducting research within the local context is important.

Therefore, this study sought to expand on the work of Baliso *et al.* (2019) and evaluate cases referred from all FPS facilities in the WC province. In addition to an expanded study period and the inclusion of all mortuaries in the province, more information pertaining to police case outcomes, positive identifications and the decedent ante-mortem records will be gathered to represent a larger context and increase the robusticity of the results pertaining to the accuracy of the demographic profiles.

1.4 RESEARCH AIMS AND OBJECTIVES

Aim 1: Evaluate the profile of anthropologically analysed human remains admitted to the FACT laboratory in the Western Cape.

Objective: Retrospectively analyse FACT case files for patterns associated with location and site of discovery, date and season of discovery, condition of remains, demographics, pathological conditions, trauma and associated evidence.

Aim 2: To evaluate the impact of FACT's anthropological analysis in the resolution of death investigations.

Objective 1**:** Evaluate police case resolution for positive identification of cases/decedents FACT have been consulted on.

Objective 2: Assess the accuracy of forensic biological profiles generated for positively identified individuals.

Objective 3: Analyse FACT case reports of unidentified individuals to ascertain potential reasons non-identification persists.

MATERIALS AND METHODS

2.1 STUDY DESIGN

This study was a retrospective and descriptive cross-sectional analysis, with a quantitative research paradigm. It included all cases that FACT have been consulted on, from FPS facilities in the WC province for the period 1 January 2006 to 31 December 2018. Approval to use the data was obtained from the Director of Forensic Pathology Services, Department of Health and the Head of FACT. Ethical approval was obtained from the Human Research Ethics Committee at the University of Cape Town (HREC REF: 263/2019) (Appendix A.1).

2.2 STUDY SETTING

Cases referred from FPS facilities in the WC province within the specified time period were included in this study. The selected study period was chosen because FPS was established in 2006, when the forensic mortuaries were transferred from the jurisdiction of the Department of Police to the Department of Health. Cases without a complete 212 affidavit were excluded from this study.

Until recently, there were eighteen FPS facilities in the WC province. This includes two academic centres in the Cape Town Metropolitan Area (SRM and Tygerberg), three referral laboratories (George, Paarl and Worcester), as well as smaller laboratories and holding centres (Beaufort West, Hermanus, Knysna, Laingsburg, Mossel Bay, Malmesbury, Oudtshoorn, Riversdale, Stellenbosch, Swellendam, Vredenburg, Vredendal and Wolseley) (Figure 2.1). However, two facilities (Stellenbosch and Swellendam) closed in 2016 and have merged with the others (De Jong, 2017).

FPS facilities are graded according to the number of decedents admitted annually, with M1-graded processing the least bodies per year (< 250) and M6 processing the most (> 2000). The majority of FPS facilities are either M1- or M3-graded, each receiving less than 1000 bodies each year. SRM and Tygerberg are the only M6-graded facilities, receiving an average of 4000 and 3000 cases per annum, respectively. They serve the West and East Metropoles of the City of Cape Town, respectively (WC Government, 2014; De Jong, 2017; Reid *et al.* 2020).

2.3 DATA COLLECTION

The data reviewed in this study were from FACT's registered database (HREC: R012/2019) (Appendix A.2). Information on the FACT database is compiled from FACT case reports and affidavits in terms of the provisions of section 212 of the Criminal Procedure Act, 51 of 1977, which document the anthropological analyses of human remains. The information categories contained in the database are listed in Appendix B.

The number of entries on the FACT database and the number of affidavits (physical copies) were counted to determine the total number of cases for inclusion in this study (n = 208). The cases were divided into forensic (n = 172) and non-forensic cases (n = 36). Non-forensic cases included those of historical or archaeological context; those recovered from modern cemeteries; and cases involving anatomical/teaching specimens or non-human remains. These cases were merely tallied to provide context and no further analyses were conducted. Forensic cases were further analysed, and all data pertaining to each case were recorded into a Microsoft Excel spreadsheet.

The variables collected from this data set as well as the variable classifications are summarised (Table 2.1 – 2.6). To determine the medico-legal facility from where the remains were submitted, the numbers 0 – 18 in the WC number were used. These data along with the police stations where the case docket was opened were used to identify the localities of FACT cases or where unidentified remains are discovered (Table 2.1).

Table 2.1 Methods of data capture or classifications pertaining to case locality (Forensic Pathology Services facilities and police precincts).

Variable	**Variable Type**	**Variable outcomes and format**
WC number	Categorical nominal	WC/ xx/xxxx/yyyy
CAS number	Categorical nominal	xxxx/mm/yyyy
Police precincts	Categorical nominal	Free text - as reported in the affidavit.
The WC number is a death register number allocated chronologically to each decedent on admission to the FPS facility. The xx in the WC number are numbers, from 01 to 18, allocated to each FPS medico-legal facility in the WC province in alphabetical order.		

To determine seasonal variations or patterns in the discovery of bodies, first, the discovery date was used to determine the months of discovery; thereafter, the seasonality was determined (Table 2.2). For cases without a discovery date, the month in the CAS number was used. CAS numbers are allocated chronologically according to the month-year when the case docket was

opened from each police station. To determine if there were delays in FACT examination post-discovery, the time between the date the body was discovered, and the date of examination was calculated in days (Equation 2.1).

$$Discovery\ to\ Examination = FACT\ Examination\ date - Discovery\ date$$

Equation 2.1 The time that elapsed between the date the body was discovered, and Forensic Anthropology Cape Town's examination calculated in days.

The time from FACT examination to when the forensic affidavit was completed was also calculated in days, where available. The FACT examination date was subtracted from the FACT affidavit or report date (Equation 2.2). These data were used to evaluate the communication between FACT and the relevant stakeholders.

$$FACT\ Examination\ to\ FACT\ affidavit = Affidavit\ date - Examination\ \ date$$

Equation 2.2 The time from examination of the remains to when the Forensic Anthropology Cape Town affidavit was completed calculated in days.

Table 2.2 Methods of data capture pertaining to body discovery and FACT examination.

Variable	**Variable Type**	**Method of Data Capture**
Date of discovery	Categorical nominal	dd/mm/yyyy
Date of examination	Categorical nominal	dd/mm/yyyy
Date of affidavit	Categorical nominal	dd/mm/yyyy

To assess patterns relating to the geographical or environmental distribution, methods of disposal and post-mortem interval of cases, the data below were collected (Table 2.3). To assess patterns in the evidentiary material or items recovered with the decedents, the number of cases recovered with clothing, associated physical evidence and entomological evidence) were counted (Table 2.3).

Table 2.3 Methods of data capture pertaining to site and context of discovery, post-mortem interval (PMI) estimations and associated evidence.

Variable	**Variable Type**	**Method of Data Capture**
Site of recovery	Categorical nominal	- Aquatic environment - Construction site - Farm/farming area - Institutions - Mountain/mountainside - Public service area - Recreational/Conservation area - Residence/residential area - Roadside

		- Vacant land/property - Vegetation area
Discovery context	Categorical nominal	- Aquatic submersion - Buried - Burnt - Covered - Enclosed - Terrestrial full exposure - Terrestrial full exposure (with scattering) - Wrapped
Post-mortem interval	Categorical nominal	- 0 – 6 months - 6 – 24 months - < 2 years - > 2 years
Crime scene photos	Categorical binary	- Present - Absent
Clothing	Categorical binary	- Present - Absent
Associated physical evidence	Categorical binary	- Present - Absent
Entomological evidence	Categorical binary	- Present - Absent
Only individuals recovered with tops and/or bottoms were considered clothed.		

The preservation or condition of the remains (taphonomic changes, completeness and fragmentation) were collected to ascertain potential reasons decedents remained unidentified and identify patterns (Table 2.4).

Table 2.4 Methods of data capture pertaining to the condition of the remains.

Variable	**Variable Type**	**Method of Data Capture**
Examination photos	Categorical binary	- Present - Absent
Taphonomy	Categorical nominal	- Early decomp. - Advanced decomp. - Skeletonised - Burnt
Completeness of skeleton	Categorical nominal	- Complete skeleton - Near-complete skeleton - Partial skeleton - Complete post-crania only - Incomplete post-crania only - Variable
Area of the body where fragmentation was observed	Categorical nominal	- Cranium - Upper limb - Lower Limb - Trunk - Multiple

		- All
In cases where taphonomy was not specified, the stage of decomposition was scored using visual criteria from crime scene and/or examination photos and description written on the affidavits based on a method outlined by Spies *et al.* 2018. In terms of completeness, a near-complete skeleton was when only a few skeletal elements were missing (mainly small bones and/or bones of the hands and/or feet). For fragmentation multiple means it occurred on more than one region of the body, but not the entire body.		

To determine the demographics of unidentified persons in FACT cases, the estimated sex, age-at-death and ancestry data were collected. Thereafter, the trauma and evidence of health and disease (pathological conditions) data were collected because they might inform us of the circumstances around death and health status of the population of unidentified individuals analysed by FACT. Lastly, the trauma and evidence of health and disease data were analysed against the sex, age-at-death, ancestry data to ascertain patterns. Stature estimation data were only collected to establish whether an estimation was made or not (Table 2.5).

Table 2.5 Methods of data capture for reported demographic, trauma (timing and mechanisms of injuries) and pathological conditions.

Variable	**Variable Type**	**Method of Data Capture**
Sex	Categorical nominal	- Male - Female - Undetermined
Age-at-death	Categorical nominal	- Juvenile - Young Adult - Middle-Old Adult - Adult - Undetermined
Ancestry	Categorical nominal	- African - Mixed - European - Mixed or African - European or Mixed - Not African - Undetermined
Stature	Categorical binary	- Estimated - Not estimated
Trauma	Categorical binary	- Present - Absent
Timing of injuries	Categorical nominal	- Ante-mortem - Peri-mortem - Post-mortem
Mechanism of trauma	Categorical nominal	- Fractures - Sharp force - Blunt force - Gunshot wound
Evidence of health and disease	Categorical nominal	- Dental pathologies - Degenerative changes - Congenital anomalies

		- Infections/disease - Occupational/habit markers - Medical interventions/dental modifications - Disruptions in growth and health state)
Individualising features	Categorical nominal	Free text - as reported in the affidavit.
Individuals of African ancestry were descended from Bantu-speaking sub-Saharan agropastoralists who migrated into the country around 2000BP (Liebenberg *et al.* 2015); those of Mixed ancestry are a biologically heterogenous group with variable and descendants of indigenous African Khoesan and Bantu-speaking sub-Saharans, migrants from parts of Europe and Asian and Madagascan Cape slaves or migrants (de Wit *et al.* 2010); and those of European ancestry are descendants of colonial populations originating from Britain, Netherlands, France, Portugal, Italy or Greece (Strull *et al.* 2014). Age-at-death was defined by the following categories juveniles (0–18 years), young adult (18–35 years), middle-old adult (> 35 years) or adults. Individuals were placed into the adult category if their estimated age range spanned both of the specified age categories, *i.e.* > 18 years.		

To assess the impact of FACT in forensic casework, first, the police case outcomes were recorded, as either open (still being investigated by the police) or closed. Secondly, the number of individuals who were positively identified was determined. Thereafter, the ante-mortem demographic information of identified individuals was collected where available to compare with the estimated demographic profiles provided by FACT. These data were obtained via follow-up with the FPS facility or the police station where the case of the decedent was opened and was incorporated into the existing FACT database (Table 2.6). Furthermore, to address the assumption that most unidentified persons are undocumented immigrants, data pertaining to the place of birth and place of intended burial of each decedent were recorded, where available.

Table 2.6 Methods of data capture for police case outcomes, probable identity, rates of identification and ante-mortem records.

Variable	**Variable Type**	**Method of Data Capture**
Case status/outcome	Categorical binary	- Open - Closed
Probable Identity	Categorical binary	- Yes - No
Identification	Categorical binary	- Identified - Not identified
Ante-mortem records	Categorical nominal	Free text - as reported in the case file.

2.4 DATA AND STATISTICAL ANALYSES

Once each variable was captured for each case, the data were analysed to address the research aims and objectives. All the data were recorded on data capture sheets and compiled into

Microsoft® Excel (Version 16.30 (19101301) for Mac 2019) and IBM SPSS® Statistics software (Version 25.0.0.0) wherein statistical analyses were conducted, and tables and graphs were generated. The alpha value for the statistical tests conducted was $p \leq 0.05$. Kolmogorov-Smirnov Test for normality was utilised to test the distribution of all continuous data. Subsequently, parametric or nonparametric tests were performed where relevant. Descriptive statistics were computed for all the data and for some more statistical tests were computed and are described below.

To assess whether FACT's overall and forensic caseload changed over time, Spearman's Rank-Order Correlation tests where fitted on the data. Mann–Whitney U-test was used to examine the effect of the formal establishment of FACT on the overall and forensic caseload. For the analysis of locality, the identified police stations were classified according to their respective murder quintiles using information from Crimestatssimplified.com (2020) to determine their murder rate.

Chi-Square tests were used to evaluate seasonal and semesterly patterns pertaining to when decedents were discovered and examined respectively. A five-number summary was calculated to determine the spread of the discovery to examination and FACT examination to the completion of FACT affidavits. To compare the differences and means in the time lapse between body discovery and FACT examination before and after the formalisation of FACT, a Mann–Whitney U-test was utilised. The Mann–Whitney U-test was also utilised to compare the differences and means in the time lapse between FACT examination and competition of FACT affidavits before and after the formal establishment of FACT.

To determine if any populations were overrepresented in FACT cases, comparisons between categories / groups within each demographic variable were investigated using Chi-squared and Fisher's Exact tests. A three-predictor logistic model was fitted to the data to test the joint association of the estimated demographics (sex, age-at-death and ancestry) and the occurrence of ante- and peri-mortem trauma and pathological conditions. Only decedents with estimations for all the reported demographic variables were included in the three-predictor logistic model (n = 126). The reference category for sex was female; middle – old-aged adults for age-at-death; and Mixed ancestry for ancestry.

The accuracy of the methods employed by FACT in casework was assessed by comparing the ante-mortem information of positively identified individuals to the estimated biological profile provided by FACT, where available. The biological sex was considered correct if the

estimated sex matched the individual's ante-mortem sex. Age-at-death was determined to be a match if the actual age of the decedent was within the range estimated by FACT.

In the FACT affidavits, stature was estimated as a range or an exact value. The FACT estimations were considered a match if the actual stature of the decedent fell within the estimated range or if it was within ± 10 cm of the estimated value. Most of the stature estimations were based on a South African population specific generic formula generated by Feldesman and Lundy (1989) and the ± 10 cm range was in accordance with their correction factors. This formula is the most accurate population specific method for South Africans.

Ancestry estimations were considered accurate if it matched with the decedents social race category, where European ancestry corresponds to the white racial category; Mixed ancestry to coloured; African ancestry to black. In instances where individuals were estimated to belong to multiple ancestral groups (*e.g.*, African or Mixed ancestry) it was considered accurate if the racial category matched either one (*i.e.*, black or coloured).

2.5 DATA MANAGEMENT

All the data were managed in accordance with the approved data management plan and were treated as confidential.

RESULTS

3.1 OVERALL NUMBER AND TYPES OF CASES

During the period from 1 January 2006 to 31 December 2018, a total of 208 cases were referred to the FACT laboratory for analysis from seventeen FPS facilities across the WC province: 88 from Salt River Mortuary, 17 from Paarl, 15 from Vredendal, 14 from Knysna, 10 from Worcester, 9 from Stellenbosch, 9 from Vredenburg, 8 from George, 8 from Hermanus, 8 from Malmesbury, 8 from Tygerberg, 6 from Mossel Bay, 3 the Beaufort West, 2 from Oudtshoorn, 1 from Laingsburg, 1 from Swellendam, 1 from Wolseley and 0 from Riversdale.

The number of cases encountered at FACT fluctuated annually, with a range 0 – 22 cases per annum (Figure 3.1). FACT's caseload did not change over time. The highest number of cases were received in 2008, 2013 and 2015, with 22 cases each. No cases were received from an FPS facility in 2006. Each year, FACT received both forensic and non-forensic cases; however, the forensic cases always exceeded non-forensic cases. On average FACT received 16 cases annually; with an average of 15 cases p.a. received before FACT was formalised and 19 cases p.a. received after. The formalisation of FACT had no significant effect on caseload.

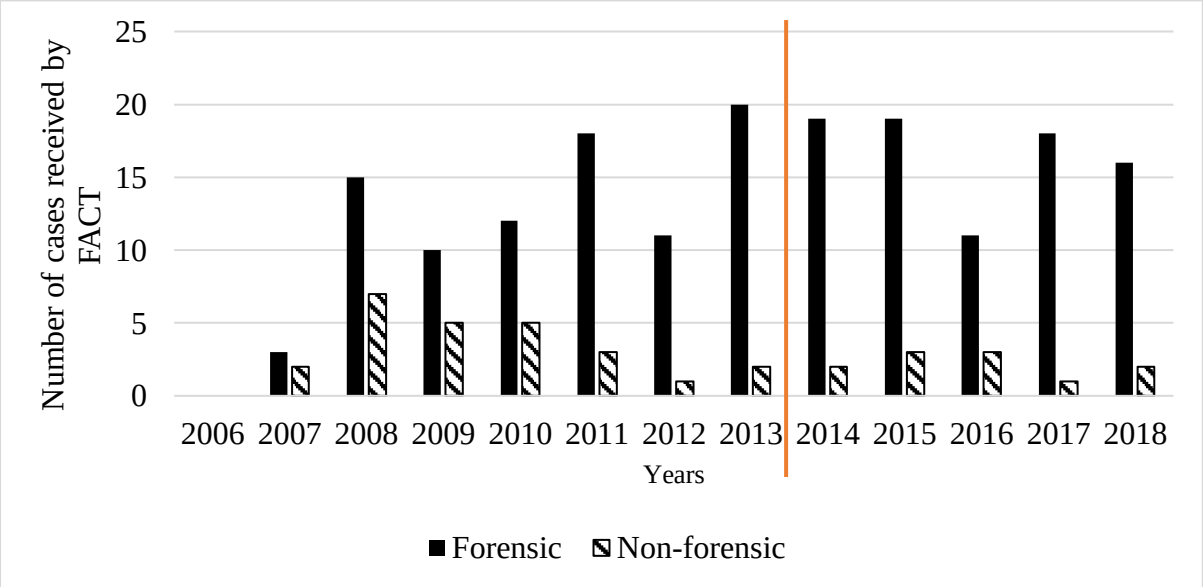

Figure 3.1 Number of cases received by the Forensic Anthropology Cape Town (FACT) laboratory per year. Non-forensic cases, including archaeological / historical cases, non-human remains, and remains used for anatomical teaching purposes are represented by diagonal lined bars; forensic cases are indicated by the solid bars. The orange line marks the formalisation of FACT as a forensic service provider. The years "before FACT" are 2006 – 2013 and the years "after FACT" and its formalisation are 2014 – 2018.

Of the 208 analysed cases, one was a radiographical age estimation of living persons; one was recovered from a modern cemetery burial; two were of non-human remains; three were of human anatomical or teaching remains; 29 were historical or archaeological; and 172 were of medico-legal significance (forensic). The classification of cases as anatomical human remains used for teaching purposes was based on a combination of observed taphonomic characteristics including sectioning, drill holes (mostly observed in cranial vaults having a suspension hole), colour changes (medium brown or dark brown), bleaching, labelling or glueing. The classification of cases as historic or archaeological was based on their taphonomy or degrees of preservation, associated artefacts and burial position; and some were subsequently confirmed through radiocarbon dating. For cases to be classified as forensic, they were distinguished from archaeological or anatomical human remains based on their taphonomic characteristics and associated artefacts. Since forensic cases were analysed further than just determining their nature, the results for their comprehensive analysis were detailed separately below.

3.2 THE PROFILE OF FACT FORENSIC CASES

The primary reason for the referral of forensic cases to FACT was to provide a demographic profile and to evaluate any traumatic or pathological conditions (97%; 166/172). Less common referrals (3%; 6/172) pertained to the interpretation of the aetiology of traumatic injuries with the decedent already identified. Although 172 forensic cases were referred to FACT for analysis, sometimes the remains of a single decedent were referred as two separate cases due to being discovered at different times and some cases involved more than one individual, resulting in a total of 174 individuals.

The trend of forensic cases encountered at FACT each year can be seen in Table 3.1. The temporal distribution of forensic cases encountered at FACT varied annually, with a range 0 – 20 cases per year. The forensic caseload increased significantly over time (p = 0.029). Most forensic cases were received in 2013 (n = 20), followed closely by 2014 and 2015 (n = 19 each). On average FACT received 14 forensic cases annually; with an average of 12 forensic cases p.a. received before FACT was formalised and 17 cases p.a. received after. While there was a general increase in forensic caseload over time, the formalisation of FACT did not have a significant effect on forensic caseload.

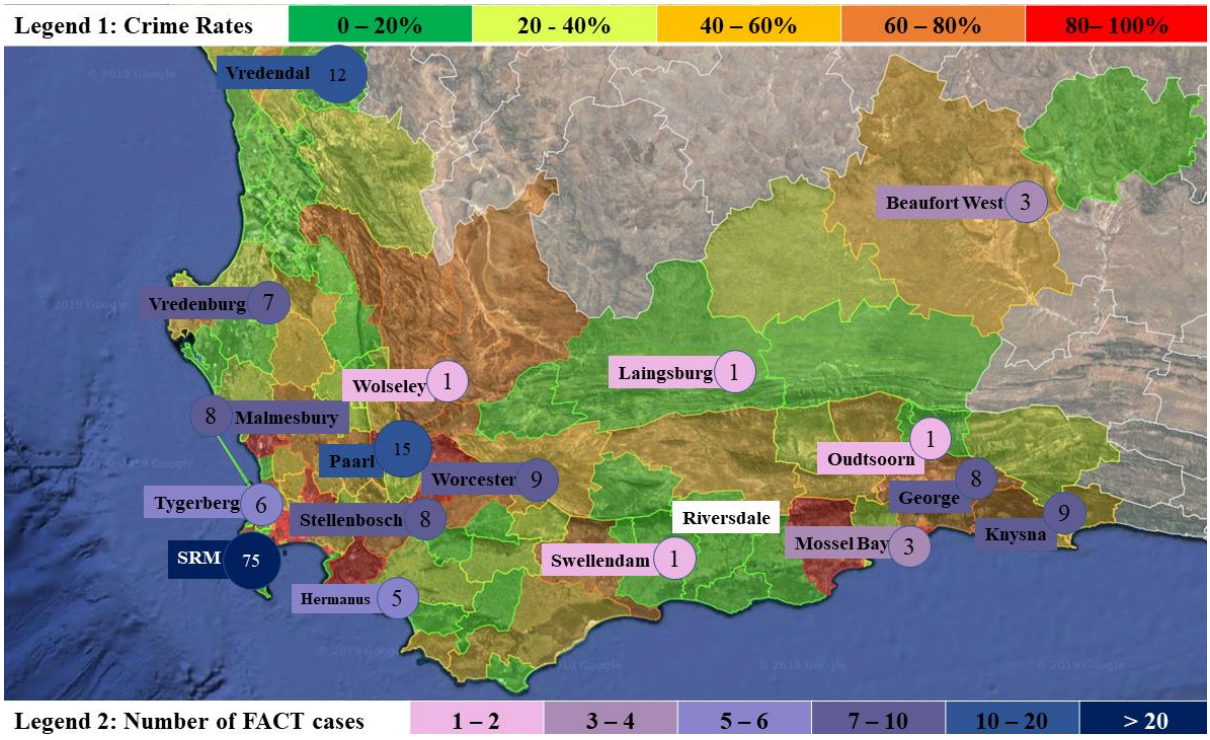

Figure 3.2 A map of the Western Cape province (WC) showing the Forensic Pathology Services where Forensic Anthropology Cape Town cases were referred from (modified from Crimestatssimplified.com (2020)). The colour of each precinct, from pink to purple to blue, indicate the number of cases referred to FACT during the study period. The colours on the map (in the background) from green to orange to red, indicate the number of murders committed in each precinct in the WC province in 2018. The first quintile shown in green (0–20 %) contains the precincts in the bottom 20 % having the least murders. The fifth quintile shown in red (80–100 %) contains the precincts that are in the top 20 % in terms of number of crimes, *i.e.*, they have the most crimes.

Figure 3.2 as well as Table 3.1 represent the distribution of referrals by FPS facility. The majority were referred from SRM (44%; 75/172), followed by Paarl (9%; 15/172) and Vredendal (7%; 12/172). The temporal trend of cases encountered from each FPS facility fluctuated annually. Each year, FACT received cases from SRM, while referrals from the other facilities were intermittent. All cases referred from the Tygerberg facility were received in a single year, 2013.

3.2.1 Case localities

To highlight common locations for the discovery of human remains, the police precincts where the cases were opened were identified. Information regarding the police stations was available in 98% (168/172) of cases. The identified police stations were depicted in Table 3.2 where

Table 3.1 Number of forensic cases received by the Forensic Anthropology Cape Town laboratory per year from 2006 – 2018, by Forensic Pathology Services facilities in the Western Cape province.

FPS Facility	Year													Total
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	
Salt River	0	1	4	4	8	7	4	7	10	10	3	8	9	**75 (44%)**
Paarl	0	0	0	2	1	1	3	1	0	2	2	1	2	**15 (9%)**
Vredendal	0	0	0	0	0	3	2	1	2	0	1	2	1	**12 (7%)**
Worcester	0	0	3	2	0	1	1	0	0	0	1	1	0	**9 (5%)**
Knysna	0	0	2	0	0	2	0	1	2	0	0	2	0	**9 (5%)**
Stellenbosch	0	1	1	0	0	0	0	1	1	3	1	0	0	**8 (5%)**
George	0	0	0	0	0	3	1	1	1	0	1	1	0	**8 (5%)**
Malmesbury	0	0	0	1	0	0	0	0	2	1	1	2	1	**8 (5%)**
Vredenburg	0	0	1	0	0	0	0	1	0	1	1	1	2	**7 (4%)**
Tygerberg	0	0	0	0	0	0	0	6	0	0	0	0	0	**6 (3%)**
Hermanus	0	0	2	0	3	0	0	0	0	0	0	0	0	**5 (3%)**
Mossel Bay	0	0	0	0	0	1	0	0	1	1	0	0	0	**3 (2%)**
Beaufort West	0	1	0	0	0	0	0	1	0	1	0	0	0	**3 (2%)**
Swellendam	0	0	1	0	0	0	0	0	0	0	0	0	0	**1 (< 1%)**
Laingsburg	0	0	1	0	0	0	0	0	0	0	0	0	0	**1 (< 1%)**
Wolsely	0	0	0	1	0	0	0	0	0	0	0	0	0	**1 (< 1%)**
Oudtshoorn	0	0	0	0	0	0	0	0	0	0	0	0	1	**1 (< 1%)**
Total	**0**	**3 (2%)**	**15 (9%)**	**10 (6%)**	**12 (7%)**	**18 (10%)**	**11 (6%)**	**20 (12%)**	**19 (11%)**	**19 (11%)**	**11 (6%)**	**18 (10%)**	**16 (9%)**	**172**

numbers reflect that multiple cases were opened from some police stations. The cases referred to FACT were opened in 76 of the 178 police stations in the WC province. Of the 76 identified police precincts, 35 were in the top 40% in terms of number of murders (high crime areas) reported in the WC province. In total, they accounted for 51% (87/172) of the cases referred to FACT. Most of the identified precincts were in townships located within the Cape Town Metropole that are characterised by low socio-economic status and high population densities.

The remainder of cases were referred from low crime areas (47%; 81/172) (Table 3.2), where most are sparsely populated suburbs or seaside towns. Table Mountain National Park, a sparsely populated recreational area, was identified as a hotspot for the discovery of human remains where five decedents were found.

Table 3.2 The police stations where cases referred to Forensic Anthropology Cape Town were opened.

FPS Facility	Police Station	Number of cases	Total (%)
Beaufort West	Beaufort West	3	**3**
George	George	3	**8**
	Pacaltsdorp	1	
	Thembalethu	4	
Hermanus	Gansbaai	1	**5**
	Grabouw	1	
	Riviersonderend	1	
	Stanford	2	
Knysna	Knysna	3	**9**
	Pletternberg Bay	6	
Laingsburg	Laingsburg	1	**1**
Mossel Bay	Da Gamaskop	1	**3**
	Great Brak River	1	
	Mossel Bay	1	
Malmesbury	Malmesbury	5	**8**
	Redelinghuys	1	
	Riebeeck West	2	
Oudtshoorn	Lady Smith	1	**1**
Paarl	Franschhoek	2	**15**
	Great Drakenstein	1	
	Klapmuts	4	
	Philadelphia	2	
	Stellenbosch	1	
	Wellington	3	
	Unknown	2	
Salt River	Athlone	2	**75**
	Atlantis	3	
	Camps Bay	3	
	Cape Town Central	10	
	Claremont	1	

	Diep River	1	
	Fish Hoek	1	
	Grassy Park	8	
	Hout Bay	6	
	Kensington	3	
	Maitland	2	
	Melkbosstrand	1	
	Milnerton	3	
	Mitchell's Plain	3	
	Muizenberg	1	
	Nyanga	4	
	Ocean View	1	
	Phillipi	4	
	Phillipi-East	1	
	Sea Point	1	
	Steenberg	1	
	Strandfontein	5	
	Table Bay Harbour	2	
	Table View	4	
	Wynberg	4	
Stellenbosch	Gordon's Bay	3	**8**
	Macassar	1	
	Somerset West	2	
	Stellenbosch	2	
Swellendam	Swellendam	1	**1**
Tygerberg	Harare	1	**6**
	Khayelitsha	1	
	Kleinvlei	1	
	Kuilsriver	1	
	Mfuleni	1	
	Unknown	1	
Vredenburg	Hopefield	1	**7**
	Laaiplek	2	
	Langebaan	1	
	Saldanha	1	
	Vredenburg	2	
Vredendal	Citrusdal	3	**12**
	Clanwilliam	3	
	Klawer	2	
	Lutzville	1	
	Vredendal	3	
Wolsely	Ceres	1	**1**
Worcester	Bonnievale	1	**9**
	Durbanville	1	
	McGregor	1	
	Touws River	1	
	Villiersdorp	1	
	Worcester	3	
	Unknown	1	

Murder quintile	0% – 20%	20% – 40%	40% – 60%	60% – 80%	80% – 100%	**Total**

	(< 3 murders p.a.)	(3 – 5 murders p.a.)	(6 – 12 murders p.a.)	(13 – 27 murders p.a.)	(> 27 murders p.a.)	
Number of police stations	13	13	14	16	19	**76**
Number of cases	20	22	39	44	43	**168**

The murder rate quintiles indicate the number of murders committed in 2018. Each precinct is colour coded. The number of total murders are sorted numerically and then divided into 5 quintiles. The first quintile contains the precincts in the bottom 20%, so they have the least murders. They are shown in green. The fifth quintile contains the precincts that have are in the top 20% in terms of number of murders, in other words they have the most murders. They are shown in red. Therefore the colour of the precinct, from green to orange to red, indicates how many murders it has in comparison to the others.

3.2.2 Body discovery and FACT examination

The forensic cases were evaluated to determine the prevalence of certain seasons and months of the year for the discovery of bodies. As shown in Table 3.3, spring was the season with the most discoveries (29%; 50/172), followed by summer (26%; 45/172), winter (23%; 39/172) and autumn (22%; 37/172). There was no significant difference in the number of bodies discovered between seasons. The peak number of cases were discovered in the month of February (n = 22 cases), followed by October (n = 18). The least likely month of discovery was June (n = 9). The season and month of discovery were unknown in two cases.

Table 3.3 Shows the distribution of cases by seasons and months of discovery and the number of cases examined by the FACT laboratory per semester and month.

Number of cases discovered		**Months**	Number of cases examined	
Summer = 45 (26%)	13	**January**	9	Semester 1 = 73 (42%)
	22	**February**	19	
Autumn = 37 (22%)	12	**March**	11	
	15	**April**	11	
	10	**May**	12	
Winter = 39 (23%)	9	**June**	11	
	13	**July**	16	Semester 2 = 89 (52%)
	17	**August**	15	
Spring = 50 (29%)	16	**September**	17	
	18	**October**	11	
	16	**November**	19	
Summer	10	**December**	11	
Unknown = 2 (1%)	2	**Unknown**	10	Unknown = 10 (6%)

In terms of FACT examination, slightly more cases were examined in the second semester of university (52%; 89/172), compared to the first 42% (73/172), but this was not significant. Most FACT examinations were conducted in the months of February and November (n = 19 cases each) (Table 3.3). The fewest examinations were conducted in the month of January (n = 9). The semester and month of examination were unknown in ten cases (Table 3.4). The date of examination was unknown due to the FACT report not being dated.

The time lapse between body discovery and when FACT conducted their examination was analysed to determine if there were delays. Only 87% (149/172) cases could be evaluated, due to 8% (13/172) not having a discovery date and 6% (10/172) not having an examination date. Most FACT examinations occurred within a month of discovery (58%; 87/149) (Figure 3.3A). A considerable number of examinations occurred three months post discovery, with some conducted after as long as three years (15%; 23/149). Overall, the number of days that lapsed between discovery and FACT examination ranged between one and 2 814 days, with an of average 100 days (median = 25 ± 297 days) (Figure 3.3A). There was no significant difference in the time between discovery of the body and FACT examination before and after FACT was formalised.

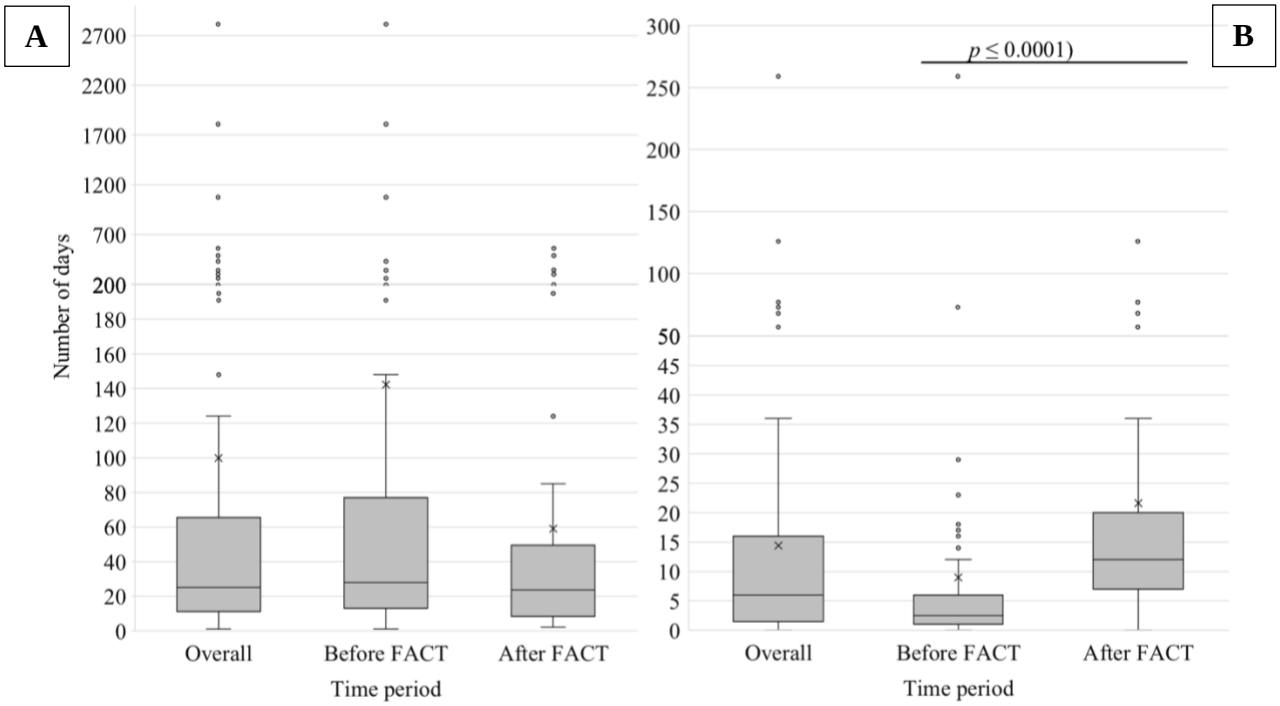

Figure 3.3 (**A)** The time taken conduct examination after discovery of human remains. Overall = entire study period (2006 – 2018); Before = before Forensic Anthropology Cape Town (FACT) was formalised (2006 – 2013); After = after FACT was formalised (2014 – 2018). Box = 25th, median and 75th percentiles; x = mean; bars = minimum and maximum values; small dots = outliers. (**B)** The time taken to complete an affidavit after FACT examination. Overall = entire study period (2006 – 2018); Before = before FACT was formalised (2006 – 2013); After = after FACT was formalised (2014 – 2018). Box = 25th, median and 75th percentiles; x = mean; bars = minimum and maximum values; small dots = outliers. The black line over bars indicates a statistically significant difference.

The time taken to complete an affidavit after examination ranged between zero and 259 days (median = 6 ± 30 days) (Figure 3.3B). Only 87% (137/172) cases could be evaluated, due to 6% (10/172) not having an examination date and 17% (23/172) not having an affidavit completion date. The majority of affidavits (92%; 125/137) were written within one month after examination, with 58% (80/136) written within one week (Figure 3.3B). Before FACT was formalised, the time between conducting the examination and completing the forensic affidavit was median = 3 ± 30 days. After FACT was formalised, the time between conducting the examination and completing the forensic affidavit was significantly slower (median = 12 ± 29 days) ($p \leq 0.0001$) (Figure 3.3B). It was observed that post FACT formalisation, the affidavits were more comprehensive and included a standardised forensic report (completed during the examination) and multiple examination photos that accompanied the affidavit. There was a major shift toward standardisation of the anthropological techniques FACT employed and an increase in documentation of findings; they became more descriptive. The early affidavits were usually just a 1/2 pages brief documentation of the analysis. However, there were no differences in the information obtained through anthropological analysis. Overall, examination photos were available in 86% (148/172) cases.

3.2.3 Site of discovery and discovery context

The forensic cases were also analysed to identify the circumstances of discovery by identifying the most common disposal sites and how the bodies were disposed. Often, FACT did not participate with crime scene recovery, having done so in only five cases. Therefore, FACT members had to rely on information provided by the forensic pathologists or crime scene photos to identify the site and context of discovery. Crime scene images were made available in only 21% (36/172) of cases.

Figure 3.4A defines the sites of recovery of individuals examined by the FACT laboratory. Vegetated areas (23%; 40/174) were the most common site where bodies were discovered, followed by the roadside (15%; 29/174), aquatic environments (11%; 20/174) and farm or farming areas (11%; 19/174). The site of recovery was unknown for 9% (15/174) of the individuals. Information about the context of discovery was unknown for 21% (37/174) of individuals (Figure 3.4B). When the context of discovery was reported, decedents were found exposed in the terrestrial environment (35%; 62/174), followed by those who were covered with things such as bedding or shrubs (14%; 25/174) and buried (10%; 17/174). One individual

was burnt and dismembered. Furthermore, five individuals were discovered in what seemed like outdoor man-made living areas, where mattresses or bedding were found, suggesting they may have been residing outdoors or living on the street. Decedents that were discovered exposed were generally found in the low crime, large geographical areas while those that were hidden were generally found in high crime areas.

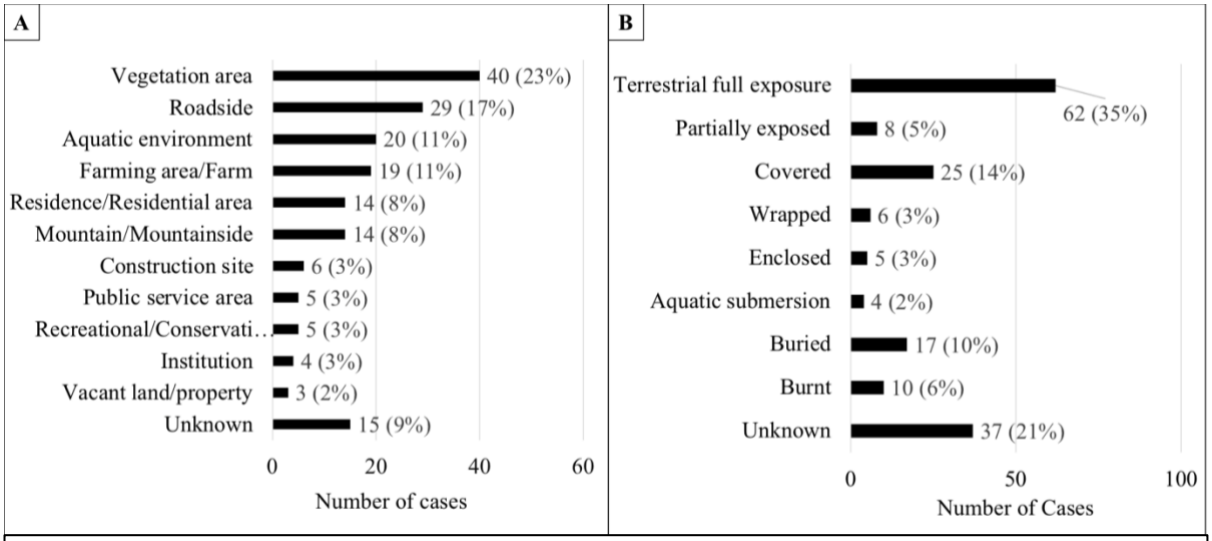

Figure 3.4 **(A)** Distribution of Forensic Anthropology Cape Town (FACT) cases by the site where the human remains were recovered. **(B)** Distribution by recovery context of cases referred to the FACT laboratory.

3.2.4 Associated evidence

Further examination of the context of discovery involved identifying the evidentiary material recovered with the decedents to discern if there were any meaningful patterns. Clothing was recovered with 58% (100/174) of the decedents. For 36 individuals, the clothing was removed prior to FACT examination and a description of the clothing was provided by the pathologist (on 13 occasions). Associated physical evidence/material such as accessories, animal remains, cords/wires, bedding, jewellery, clothing and identity documents were recovered with 42% (73/174) of the decedents. Some of these materials were reported to have been used to cover or hide (particularly the bedding and clothing) or restrain (cords) the decedents. Entomological evidence was reported to have been recovered with 44% (76/174) of the human remains and were utilised in the estimation of the PMI.

3.2.5 Condition of the remains

To assess the condition of the bodies when they were examined, the taphonomic changes and completeness were examined. Since FACT was rarely requested to assist with body recovery, the number of skeletal elements recovered was not necessarily indicative of skeletal elements discovered. In some cases, typically those referred for trauma analysis only, a greater portion of skeletal elements were recovered but only the bones to be analysed for injuries were submitted to FACT. In addition, case records indicated that 14% (24/174) of the bodies were macerated or had soft tissue removed, with seven macerated or cleaned prior to FACT examination. Furthermore, the reports also indicated that seventeen decedents had too much soft tissue, which impeded FACT analysis. In such cases, full body X-ray images aided in the analysis and the demographics were estimated from the soft tissue, where possible.

At the moment of their examination, the majority of decedents were skeletonised (70%; 121/174), followed by those who were in advanced decomposition (19%; 33/174) (Figure 3.5A). Of the eleven burnt decedents, for three there were signs of it being deliberate human action, five were suggested to have been burnt during informal settlement fires (n = 5) and wildfires (n =3). Fifteen decedents were also mummified or had mummified tissue, with eight being in advanced decomposition and seven being skeletonised. For the majority of the examined individuals a near-complete skeleton was available for analysis (55%; 96/174), followed by those who only had a partial skeleton (17%; 29/174) (Figure 3.5B). Single bone discoveries were mainly of the femur (in three cases) and were discovered in aquatic environments (in four cases).

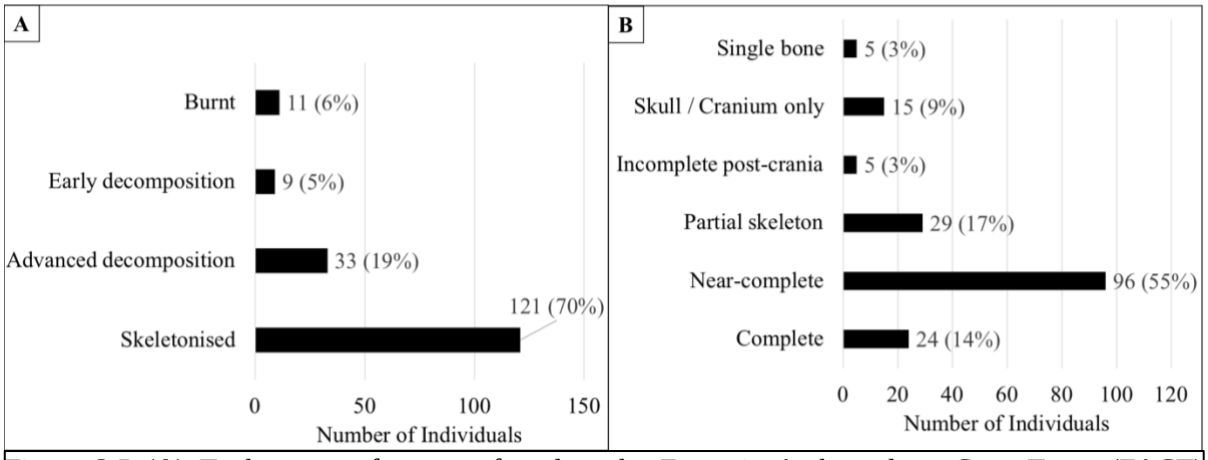

Figure 3.5 **(A)** Taphonomy of cases referred to the Forensic Anthropology Cape Town (FACT) laboratory. **(B)** Degree of completeness of human remains analysed by the FACT laboratory.

The PMI for most of the analysed individuals was between 0 – 6 months (31%; 53/174), followed by 6 – 24 months (14%; 25/174). For the remainder of the decedents, their estimated PMIs did not fit into any of these specific categories (23%; 41/174). PMI estimations were not available for 32% (55/174) individuals. Most of the individuals analysed were not fragmentated (69%; 120/174). Where fragmentation was observed (31%; 54/174), for 20 individuals the entire skeleton was fragmented, for 14 only the cranium, for 13 multiple regions of the body and for 6 individuals only the limbs. Less than 1% (1/174) individuals had trauma on the ribs only. The fragmentation was reported to have been caused by burning, scavenger activities, peri-mortem injuries or inadequate recovery methods.

3.2.6 Reported demographics

The reported demographics were examined to identify the populations represented in FACT cases. To estimate sex, FACT anthropologists routinely utilised non-metric/morphological traits of the cranium (Buikstra & Ubelaker, 1994) and pelvis at the points of the pubic symphysis (Phenice, 1969) and the greater sciatic notches (Buikstra & Ubelaker, 1994). Less frequently, the anthropometry of long bones, particularly of the femur and the assessment of the entire skeleton for differences related to the general principle of robusticity (or lack thereof) were used to estimate sex.

Of the 174 decedents analysed, significantly more were male (67%; 116/174) compared to female (28%; 49/174) ($p \leq 0.0001$). Sex was indeterminate for 5% (9/174) of decedents due to fragmentation or missing the skeletal elements required for sex estimations (such as the *os coxae*) or because the decedents were neonates or pre-adolescent. In cases where sex was estimated for pre-adults, it was due to remaining genital soft tissue. A greater number of estimated males than females were examined each year, except for in 2007 and 2018 (Figure C.1).

Age-at-death estimations were typically reported as age ranges where the unidentified individual presumably fell within. FACT anthropologists utilised a combination of ageing methods. The most frequently used methods included the Suchey-Brooks method on the pubic symphyseal surface (Suchey *et al.* 1990); in conjunction with methods associated with the pattern of cranial suture closure (Buikstra & Ubelaker, 1994), changes in sternal end of the 4th rib (İşcan *et al.* 1985; İşcan *et al.* 1993), epiphyseal fusion (Schaefer *et al.* 2009), changes in auricular surface of the ilium (Buckberry and Chamberlain, 2002) and/or sequence of

formation and eruption of the teeth (Ubelaker, 1989; Buikstra and Ubelaker, 1994; Esan and Schepartz, 2018). The combination of methods utilised was dependent on the preservation (degrees of completeness, taphonomic state and/or fragmentation) of the skeleton.

The majority of individuals were estimated to be middle to old-aged adults (54%; 94/174), followed by young adults (17%; 29/174) and juveniles (12%; 20/174). Approximately 17% (29/174) of the decedents estimated to be adults could not be assigned to a more specific age range. Age-at-death was indeterminate for 1% (2/174) of individuals. For one individual, age-at-death was indeterminate due to the skeleton being extremely fragmented and the other individual was already identified. There were generally more males than females in all age-groups groups (Appendix C, Table C.1).

Ancestry estimations by FACT were primarily conducted using non-metric/ morphological traits by Hefner and L'Abbe (İşcan and Steyn, 2013: 203-211); nasal bone contour, nasal aperture width, anterior nasal spine, inferior nasal margin, zygomatic projection, malar tubercle, interorbital breadth, zygomaxillary suture and alveolar prognathism. Where ancestry was assessed, 37% (65/174) of the decedents were of Mixed ancestry, 22% (39/174) were of African ancestry and 3% (6/174) were of European ancestry. Decedents who displayed a variety of traits from multiple ancestral groups or had phenotypes not typical of one ancestral group accounted for 12% (20/174) of the sample. One individual was reported to not be of African ancestry; two were estimated to be either of European or Mixed ancestry; and seventeen were estimated to be either of Mixed or African ancestry. Ancestry was indeterminate for 25% (44/174) of decedents often due to the cranium being either unavailable for analysis or extremely fragmented. In addition, ancestry was routinely indeterminate for many pre-adults. All of the individuals estimated to be of European ancestry only were adult males. There were more men than females in all ancestral groups (Appendix C, Table C.2).

Stature was mostly estimated using the length of the femur as a ratio of overall height (İşcan & Steyn, 2013), using the generic formula developed by Lundy & Feldsman (1989). However, occasionally, stature was estimated from measurement of the entire body or anthropometric measurements of the humerus or ulna. Stature estimations were present for the majority of individuals (69%; 120/174). Where stature was not estimated it was because post-cranial skeletal elements were not recovered, or those recovered were fragmented or had too much soft tissue present for an accurate estimation.

3.2.7 Trauma and pathological conditions with demographics

The timing and mechanism of trauma and pathological conditions observed in the individuals examined are summarised in Table 3.4, where numbers show that some individuals had more than one type of traumatic or pathological event. The trauma and pathological conditions data were also assessed against the reported demographics to discern trends (Figures 3.6 – 3.8). Ante-mortem injuries were present in 41% (72/174) individuals (with a sum of 82 lesions), with the most common being healed fractures of mostly unknown causes (n = 73) or injuries caused by a sharp force (n = 3) or blunt force (n = 5) (Table 3.4).

Table 3.4 The classification of trauma by timing and mechanism of injury of individuals examined by the Forensic Anthropology Cape Town (FACT) laboratory.

Timing of Trauma	Number of individuals	Mechanism of injury	Number of events	**Total number of Events**
Ante-mortem	72	Healed fractures	73	**82**
		Sharp force	3	
		Blunt force	5	
		Scarring from burning	1	
Peri-mortem	50	Fractures	25	**69**
		Blunt force	10	
		Sharp force	10	
		Asphyxiation	8	
		Gunshot wound	5	
		Burning	5	
		Laceration	2	
		Sharp/Blunt force	2	
		Herniation	1	
		Bruising	1	
Post-mortem	64	Scavenging	26	**73**
		Root activity	15	
		Burning	13	
		Breakage	12	
		Sharp force	3	
		Blunt force	2	
		Other	2	

Ante-mortem = injuries sustained during life, with evidence of healing often present; Peri-mortem = injuries sustained at or about the time of death, and often contribute to the cause of death; Post-mortem = Post-mortem = sustained after death, usually caused environmental or animal action (Lundy, 1998).

Figures 3.6 – 3.8 and Table C.3 (Appendix C) show the relationship between reported demographics and ante-mortem trauma for the decedents examined by the FACT laboratory. According to the three-predictor logistic model, only the overall relationship between ante-

mortem trauma and sex was significant (p = 0.019). Males were three times more likely than females to present with ante-mortem trauma. This indicates that male sex was the most significant factor contributing to the likelihood of an individual having ante-mortem trauma, regardless of age-at-death or ancestry.

While the overall association between age-at-death and ante-mortem trauma was non-significant, there was a significant difference in the prevalence of ante-mortem trauma between middle – old-aged adults and young adults and adults. Middle – old-aged adults were three times more likely than both young adults (p = 0.047) and adults (p = 0.025) to have ante-mortem trauma. The overall relationship between ancestry and ante-mortem trauma was non-significant due to confounding by sex (male consistently outnumbered female in all ancestral groups). In all, these data suggest that being a middle – old-aged adult man was the most significant factor contributing to the likelihood of a decedent presenting with ante-mortem trauma, regardless of ancestry.

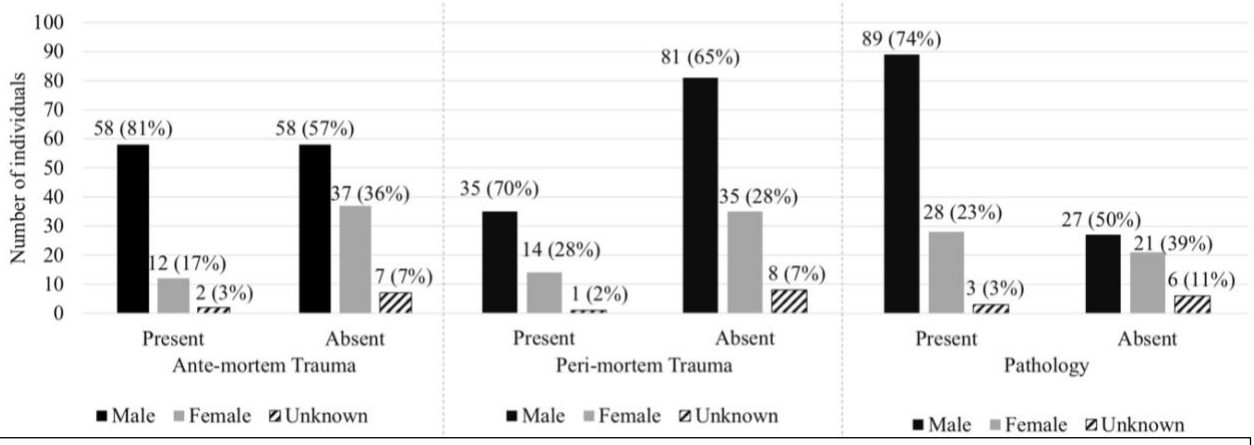

Figure 3.6 Ante-mortem trauma, peri-mortem trauma and pathological conditions organised according to estimated sex. The percentage in the brackets represents the number of males/females/indeterminate decedents as a percentage of the total number of decedents with ante- and peri-mortem trauma and pathological conditions.

Peri-mortem injuries were observed in 29% (50/174) individuals (with a total of 69 lesions) and were mainly due to fractures (n = 25) (Table 3.4). According to the three-predictor logistic model, only the overall relationship between peri-mortem trauma and ancestry was significant (p = 0.017). Decedents of African and European ancestry were three (p = 0.045) and ten (p = 0.018) times more likely to present with peri-mortem trauma than those of Mixed ancestry, respectively. This suggests that ancestry (or being of African or European ancestry) was the

most significant factor contributing to the likelihood of a decedent presenting with peri-mortem trauma, regardless of sex or age-at-death.

In terms of sex, the likelihood of males and females presenting with peri-mortem trauma were equal. While the overall association between peri-mortem trauma and age-at-death was non-significant, young adults were four times more likely to have peri-mortem trauma than middle – old-aged adults and the relationship was significant (p = 0.022). Notably, juveniles were three times more likely to present with peri-mortem trauma than middle – old-aged adults.

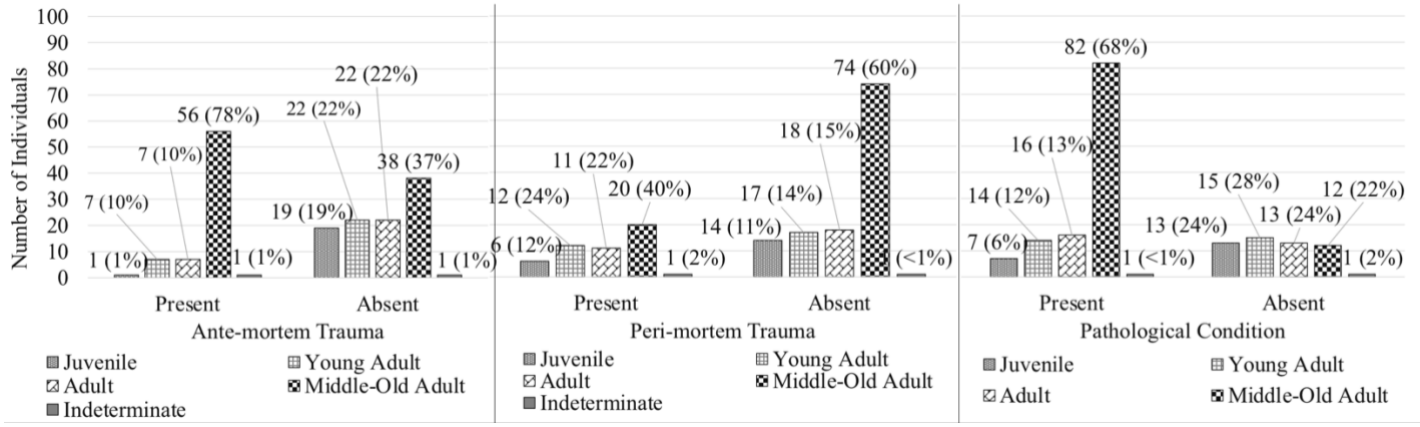

Figure 3.7 Ante-mortem trauma, peri-mortem trauma and pathological conditions organised according to estimated age-at-death. The percentage in the brackets represents the number of juveniles/young adults/adult/middle – old-aged adult decedents as a percentage of the total number of decedents with ante- and peri-mortem trauma and pathological conditions.

Post-mortem trauma was observed in 37% (64/174) individuals (with a total of 73 occurrences) and could be attributed mostly to scavenging (n = 26), root activity (n = 15), burning (n = 13) and breakage (n = 10) (Table 3.4). Post-mortem trauma was noted as major contributor to skeletal alterations or damage (such as fragmentation or absence of some skeletal elements) observed on the skeletons.

Pathological conditions were present in 69% (120/174) of the examined decedents, where some individuals exhibited multiple conditions. The most commonly observed pathologies were due to dental decay or modification (*e.g.*, cavities), degenerative diseases (*e.g.*, osteoarthritis or spondylosis), bone alterations or abnormal bone formations (*e.g.*, ossification of costal cartilages). Other pathological conditions observed were due to infections or diseases (*e.g.*, cribra orbitalia), osteoporosis (*e.g.*, vertebral collapse), occupational/habit markers (*e.g.*, myositis ossificans), congenital defects (*e.g.*, spina bifida) or growth disruptions (*e.g.*, enamel hypoplasia) among others.

According to the three-predictor logistic model, only the relationship between age-at-death and pathological conditions was significant (p = 0.001). Middle – old-aged adults were 18 times more likely to have pathologies than juveniles (p = 0.001), 11 times more likely than young adults ($p \leq 0.0001$) and 6 times more likely than adults (p = 0.007). This indicates that age-at-death (or being a middle – old-aged adult) was the most significant factor contributing to the likelihood of a decedent presenting with pathological conditions, regardless of sex or ancestry. In terms of sex, the odds of males and females having pathological conditions were generally the same. Decedents of Mixed ancestry were three and two times more likely to present with pathologies than those of European ancestry and those in the Mixed or African category.

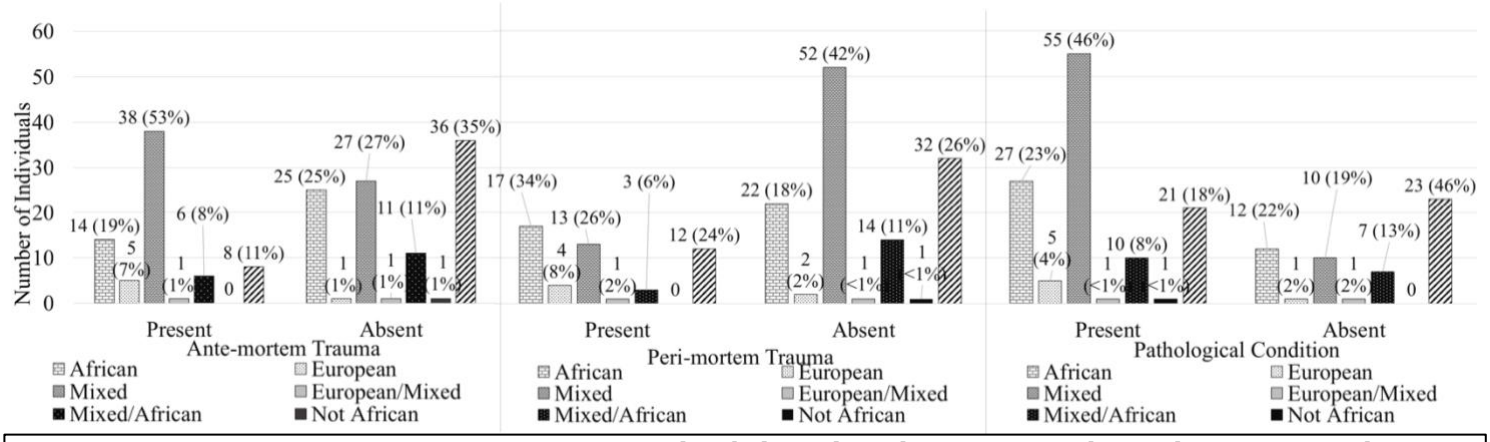

Figure 3.8 Ante-mortem trauma, peri-mortem trauma and pathological conditions organised according to estimated ancestry. The percentage in the brackets represents the number of African/European/Mixed/Mixed or African/Non-African decedents as a percentage of the total number of decedents with ante- and peri-mortem trauma and pathological conditions.

The data were further analysed to determine if the decedents presented with any distinguishing features that could have aided in their identification. Individualising features such as a tattoos, ante-mortem injuries or medical/dental interventions and unique/abnormal anatomical variants morphology were observed in 36% (63/174) of individuals. Only two decedents had individualising features that aided in their identification. In one case, a healed blunt force trauma on the cranium was linked to information given by the family. In another case, identification was aided by a family member describing the decedent had a diastema between the two upper incisors.

3.2.8 Case outcomes and rates of positive identification

Information regarding police case outcomes and decedent positive identifications were examined to determine the contribution of FACT in judicial investigations. Nearly half of the cases referred to FACT have since been closed (49%; 85/172) and 28% (48/172) were still under investigation by the police at the time of this study. In 23% (39/172) of cases, information regarding the case outcome was not available. Notably, FACT members were requested to give expert testimony in court in only nine cases. Generally, they were required to explain their findings of the estimations.

Information regarding positive identification was reviewed for 168 individuals since six decedents were already identified and were referred solely for the interpretation of the aetiology of traumatic injuries. Among the 168 individuals, 37% (61/168) reached a positive identification, 49% (84/168) were unidentified and for 14% (23/168) information about positive identification was unavailable. For 59% (36/61) of identified individuals the case has been closed by the police while 26% (16/61) of cases were still being investigated. Nine positively identified individuals who were unclaimed at the mortuary were buried by the state as paupers and one was donated to UCT's Division of Clinical Anatomy and Biological Anthropology in the Department of Human Biology and subsequently, accessioned into the UCT Human Skeletal Repository. For 52% (44/84) of unidentified decedents, the cases were also closed by the police. Some of these decedents were either buried as paupers (n = 30) or donated to UCT (n = 10).

The affidavits were examined to identify potential reasons related to the forensic anthropological analysis of why some decedents could be identified and others remained unidentified. There are several factors that influence the identification of unknown decedents including, but not limited to, the ability to estimate demographic variables, the degree of completeness of the analysed remains, the presence of a probable identity or identifying personal items or unique skeletal features and having access to antemortem records for comparisons.

Only the presence of a probable identity had a significant association with positive identification ($p \leq 0.0001$), with decedents who had a probable identity being twelve times more likely to be identified than those who did not have one (regardless of any of the abovementioned factors). The presence of a probable identity was reported for 41 decedents and 81% (33/41) of them reached a positive identification. These decedents either had

identifying documents or were suspected missing persons. Decedents of European and African ancestry had higher rates of identification compared to those of Mixed ancestry. The rates of positive identification for decedents estimated to be of European and African ancestry were 83% (5/6) and 65% (20/31) respectively. Individuals with indeterminate ancestry by anthropological methods were positively identified in 44% (15/34) of cases. The lowest rates of identification were observed for decedents estimated to be of Mixed ancestry (31%; 17/55), European or Mixed ancestry (33%; 1/3) and Mixed or African ancestry (19%; 3/16) (Table 3.5). Decedents of African and European

There was no significant association between positive identification and the degree of completeness, however, there was a general increase in the rate of positive identification when more skeletal material was available for analysis. The relationship between estimated age-at-death and identification was also insignificant, however, there was a general decrease in positive identification rate with increased age. In terms of sex, the rate of positive identification for decedents whose sex was indeterminate (63%; 5/8) was higher than those estimated to be male or female, whose rates were equal (41% for both, 41/100 and 15/37 respectively) (Table 3.4).

Positive identification had an insignificant association with the presence of ante-mortem trauma, individualising features, clothing or associated physical evidence. The positive identification data were also analysed by the FPS facilities the decedents were referred from to discern if mortuary caseloads would affect identification. Decedents referred from the Worcester facility had the highest rate of positive identification (89%; 8/9), followed by Tygerberg (60%; 3/5), Vredendal (55%; 6/11) and SRM (48%; 29/60). The lowest rates of identification were observed for decedents referred from the George (13%; 1/8) and Paarl (18%; 3/17) facilities (Table 3.4).

It is often assumed that many, perhaps most, of unidentified decedents are undocumented foreign immigrants. Therefore, information pertaining to the decedents place-of-birth, intended place-of-burial were analysed to test this presumption. From the 22 decedents that had information regarding place-of-birth and/or intended burial, ten were born in the WC province. For all these decedents their place of birth and burial were the same. Eight decedents were born in the Eastern Cape and for six their place of birth and burial were the same. For one individual born in the Eastern Cape the place of burial was Cape Town and for the other no information was unavailable. Only one decedent was reported to have been born in the Northern Cape Province. Three decedents were foreign internationals, with one born in Zimbabwe, another in

Ghana and the other in the Netherlands. The intended place-of-burial for all three decedents were their respective places-of-birth. These data (place-of-birth and intended burial being the same) suggests that at least some of these decedents were not residing in the WC province permanently.

Table 3.5 Identification rates by degree of completeness and estimated sex and age-at-death.

	Total number of individuals	**Rate of Identification**
Degree of completeness		
Single post-crania bone	1	0%
Cranium / Skull only	13	31%
Incomplete post-crania	3	33%
Partial skeleton	24	46%
Near-complete	81	40%
Complete	23	57%
Age-at-death		
Juvenile	16	56%
Young Adults	24	50%
Adults	23	48%
Middle – Old-aged Adults	81	36%
Indeterminate	1	0%
Sex		
Male	100	41%
Female	37	41%
Indeterminate	8	63%
FPS Facility		
Beaufort West	2	50%
George	8	13%
Hermanus	5	20%
Knysna	9	22%
Laingsburg	1	0%
Malmesbury	8	38%
Oudtshoorn	1	100%
Paarl	17	18%
Salt River	60	48%
Stellenbosch	4	25%
Tygerberg	5	60%
Vredenburg	5	40%
Vredendal	11	55%
Worcester	9	89%

3.2.9 The accuracy of reported demographics

The accuracy rates of the reported demographics were evaluated to determine the precision of FACT's anthropological techniques in casework. These analyses were challenging as information regarding the ante-mortem demographic records of the identified decedents was absent or difficult to obtain. Only 55 individuals had ante-mortem sex information available.

However, six decedents with known ante-mortem sex were indeterminate. Overall, sex comparisons were made for 49 individuals and the accuracy rate was 98% (48/49). The one decedent with an incorrect estimation also had their age-at-death misclassified. This decedent was the only one (of the 49) without a cranium.

In terms of age-at-death estimation accuracy, ante-mortem information was available for only 51 of the positively identified individuals. Where comparisons were made, the estimated age-at-death was correct in 80% (41/51) of cases. The age-at-death for the misclassified decedents was an overestimation in seven cases and underestimation in three. From the affidavits, it was noticeable that the overestimated decedents presented with pathological conditions or gross age-related morphological changes in the skeleton or dentition often observed in older individuals. For the underestimated decedents, it was observed they tended not to present with any of the age-related morphological changes in the skeleton or dentition often observed in individuals of their age-groups. Notably, it is possible that for the one decedent it was due to an incorrect sex estimation (mentioned above), as some age-at-death estimation standards are sex specific.

Ante-mortem ancestry information was available for only 48 decedents. However, due to the cranium being absent or fragmented, ten decedents with known ante-mortem ancestry did not have an estimation for comparison. In all, ancestry comparisons were made for 38 individuals and the accuracy rate was 84% (32/38). Four of the misclassified decedents were estimated to be of Mixed ancestry, but ante-mortem information indicated that three were black and one was white. The remainder were estimated to be of African ancestry, however, ante-mortem information indicated that they were coloured.

The examination of the accuracy of stature estimations was precluded by the lack of ante-mortem stature information. Only four individuals had ante-mortem stature records available and the accuracy was 100% (4/4). Since stature analysis is population specific, it was investigated whether incorrect estimations of ancestry would result in incorrect stature estimations. For all four of these decedents the ancestry estimations were correct.

DISCUSSION

Each year, thousands of decedents remain unidentified in South Africa – particularly those who are decomposed. This may be attributed to overwhelming caseloads faced by investigating authorities, continual flow of people within and into the country and lack of medical records (Naidoo, 2007; Evert, 2012). Data regarding anthropologically analysed cases in the country is limited, with only three studies having been published to date (Steyn *et al.* 1997; Steyn *et al.* 2016; Baliso *et al.* 2019). In addition, little is known about the contribution of anthropological analyses in the South African forensic setting. One study has examined the impact of anthropological analyses in forensic casework; however, it was limited in its scope.

The following discussion outlines the context wherein forensic anthropology operates in the WC province. This is important to understand the challenges and limitations faced by practitioners in this field and how that impacts their analyses. This was followed by a description of the profile of FACT cases to identify patterns relating to anthropologically analysed decedents that can be informative to the scientific and legal communities. Thereafter, the contribution of FACT to case resolution and positive identification is provided with an outline of all the potential factors related to the anthropological analysis that may have hindered or assisted with identification.

4.1 OVERALL NUMBER AND TYPES OF CASES

The central questions addressed in this section pertain to the types of FACT cases, how often consultations were made and the effect of formalisation on FACT service delivery. This was done to establish whether FACT was consulted on all cases needing forensic anthropological input in the province and to determine if formalisation led to an improvement or increase in service delivery or caseload.

The overall forensic caseload (mean = 14) in this study was generally smaller than that of international studies in both developed (Grisbaum and Ubelaker, 2001; Komar, 2003) and developing countries (İşcan and Olivera, 2000; Vaz and Benfica, 2008; Evison *et al.* 2012), where cases averaged between 16 – 23 p.a. and 14 – 32 p.a. respectively. The forensic caseload was also lower compared to the annual caseload at FARC also in South Africa, that reported an average between 30 and 90 cases per year (1996 – 2013) (Steyn *et al.* 2016). It is important to note that FACT was not consulted on all decomposed or skeletonised in the WC province. Data from Reid *et al.* (2020) study revealed that between 2010 – 2017, 345 (mean = 43)

decedents admitted at SRM were reported as physically unidentifiable due to decomposition, burns, skeletonisation or other means. This is almost six times the number of cases FACT was consulted on during the same time period. These data show that FACT was not consulted on all cases that needed anthropological input from SRM. Thus, it is also possible that not all decomposed cases were referred to them from the other FPS facilities as well.

Furthermore, the results showed that FACT members rarely attended scene or assisted with body recovery, having done so in only five cases. This is in-line with trends seen in anthropology laboratories all reporting similar experiences (İşcan and Olivera, 2000; Grisbaum and Ubelaker, 2001; Evison *et al.* 2012; Steyn *et al.* 2016). Only SMLC in the United Kingdom reported frequent recoveries, having attended scene in about two-thirds of cases and recovering remains in about half of these (Evison *et al.* 2012). When FACT was consulted, the results showed significant delays between body discovery and examination as it took about 100 days (median = 25 ± 297 days) for FPS and/or SAPS to refer cases (Figure 3.3). Thus, all these findings indicate that FACT's services were underutilised in the WC province and consultations were delayed.

The underutilisation of FACT and delayed consultations may be due to several factors, one being the discretion of the forensic pathologists assigned to the cases. Some pathologists may not believe in the validity and reliability of forensic anthropology as a discipline (Smith, 2020). Others may have anthropological training or knowledge and may feel that anthropologist will not provide them with any information they could not gather from the skeleton themselves. The availability of FACT members may also have affected how frequently and when they were consulted. FACT is operated by full-time academic staff and with postgraduate student assistance, who have primary commitments at UCT, including teaching and research. There is more anthropological teaching required in the first semester than the second. This is evidenced by most of examinations being conducted in the second semester compared to the first (Table 3.3). Other factors may have included the increase in service providers in the province and the lack of resources, such as finances to pay for consultation.

For scene recoveries specifically, the safety of FACT members had to be considered since approximately half of the decedents were recovered in high crime areas. These areas tend to have poor road infrastructure and accessing them can be challenging. Additionally, public service workers, particularly paramedics are often robbed, assaulted or murdered when they enter these areas without a blue escort (Brady *et al.* 2019).

The need for forensic anthropological input in the WC province is further demonstrated by the significant number of cases of archaeological origin (14%, 29/208). Archaeological sites are widespread across the WC province, located in both inland and coastal regions. Cape Town is the oldest city in South Africa and has many informal burial areas and is rich in Later Stone Age sites (Sealy *et al.* 2004; Orton, 2010). Consequently, the inadvertent discovery of archaeological or historic remains is a perennial problem in the province. The distinction between archaeological and forensic remains is important to ensure that police and FPS resources are not wasted on investigations that are not their mandate. Archaeological remains are the responsibility of the SAHRA (National Heritage Resources Act 25 of 1999).

The identification of archaeological remains is also important for the protection and preservation of South African Heritage. The restitution and reburials of historical remains are of great significance to the healing and closure of descendent communities (Morris, 2014; Smith, 2015). The fact that archaeological remains were frequently referred to FACT through FPS is notable and shows the lack of training for law enforcement to recognise them. Forensic anthropologists are well equipped to assist in skeletal remains recoveries as they have training in the excavation and identification of archaeological remains.

The variation in the number of cases referred for analysis from each FPS facility can be explained in relation to the number of decedents admitted at each facility annually. The number of referred cases from each mortuary were generally relative to the number of decedents they admit annually. Mortuaries that admitted more decedents annually tended to consult FACT on more cases than those that admitted fewer decedents each year (Figure 3.2). Most cases were referred from SRM (Figure 3.2), one of the two busiest mortuaries in the province (admitting more than 3000 decedents each year) (Reid *et al.* 2020). The larger number of referrals from SRM may be due to both being affiliated with UCT. FACT members generally have a working relationship with pathologists at the facility as they are all colleagues. SRM is also in close physical proximity to FACT, with them located only 2 km apart, possibly making it easier for FACT members to attend to cases at this mortuary or for bodies to be transported to their laboratory.

The formalisation of FACT did not have a meaningful effect on caseload. This was inconsistent with observations at the Smithsonian (Grisbaum and Ubelaker 2001), Porto Alegre (Vaz and Benfica, 2008), and Montevideo (İşcan and Olivera 2000) where the general trend was an increase in caseload following the establishment of the forensic anthropology unit. A possible explanation for the lack of an effect of formalisation of FACT on forensic caseload

may be due to them being a fully functioning unit before contractual obligations were in place, already providing the service.

The highest number of forensic cases were received between 2013 – 2015. The peak in cases in this period was possibly related to FACT having a full-time laboratory manager from mid-2012 until 2014, who worked closely with pathologists and the police. The high number of cases in those years may have also been influenced by the formal contract signed between FACT and both the SAPS and FPS. The decline of cases in 2016 is possibly due to the dissolving of the manager position and termination of the contract with SAPS that year. These findings demonstrate the need for good communication channels and understanding between stakeholders is necessary for the effective use of anthropological input in casework. Evidence suggests that the presence of a full-time manager at FACT may have resulted in better consultations, motivating for this position to be reinstituted.

While the formalisation of FACT did not significantly affect caseload, it did impact the preparation and style of the affidavits. Post-examination, affidavits are submitted to pathologists or the police to collate and match to an antemortem description of a missing person. Affidavits written by FACT members were completed at a significantly slower rate after formalisation (median = 12 ± 29 days) compared to before (median = 3 ± 30 days) (Figure 3.3). There was a temporal change in the manner the affidavits were written, and the scope of the information documented; with affidavits written after FACT was formalised being more comprehensive while before the affidavits were generally a brief 1 – 2 pages. While it is important that affidavits be completed quickly so that the police can progress with their investigations, it is also important that the anthropological findings are documented thoroughly. The documentation and standardisation of anthropological techniques in affidavits submitted to court may be important in creating or upholding forensic anthropology standards that can be defended in a South African court.

Overall, the abovementioned confirm that there is a need for forensic anthropology in the WC province. Taking the challenges faced by forensic anthropologists in practice into consideration, for the potential impact of the discipline to be realised, legislation of the field is needed. Moreover, it may be necessary for forensic anthropologists to be employed within law enforcement agencies and the Department of Health.

4.2 THE PROFILE OF FACT FORENSIC CASES

4.2.1 Site & context of discovery, associated evidence and condition of the remains

The previous section outlined the context wherein forensic anthropology operates in the WC province and the challenges encountered by practitioners in this field. These challenges, *i.e.,* FACT rarely assisting with body recovery and delayed consultations, had a significant impact on the FACT's analysis, particularly the interpretation of taphonomic changes and precision PMI estimations.

The trend of taphonomic changes in this study, with the majority of bodies being skeletonised (70%; 121/174) at the moment of FACT examination (Figure 3.5A) corresponded with the pattern observed in the Montevideo (İşcan and Olivera, 2000), Smithsonian (Grisbaum and Ubelaker, 2001), SMLC, CEMEL (Evison *et al.* 2012) and FARC (Steyn *et al.* 2016) laboratories. The taphonomic changes of the bodies encountered at FACT are probably related to remoteness of the disposal sites and the bodies being hidden. Eleven decedents were reported to have been burnt (Figure 3.5A) and in the affidavits there were indications that informal settlement fires, wildfires and deliberate burning were the probable cause. Wildfires are a common occurrence during the hot and dry summer season and are most often started intentionally or accidentally by people (WC Province Government, 2020). These fires bring down the Fynbos (fine-leaved grass or shrubs), exposing human bodies. Steyn *et al.* (2016) also noted the common occurrences of veldt fires, which often led to the discovery of many of the bodies they analysed.

Cape Town has the highest overall fire-related death rates in the country, mainly due to informal settlement fires and community retaliation or vigilantism (Donson, 2009; Walls *et al.* 2017). Community vigilantism can involve placing a petrol dowsed rubber tire around the neck of a person and setting them on fire (Lerer, 1994). On an annual basis around 500 deaths due to informal settlement fires occur in Cape Town and community retaliation accounted for about 4% of deaths in WC province 2017/18 (SAPS Annual Crime Report, 2019). The proliferation of informal settlements (Walls *et al.* 2017) and the increased community retaliation due to the rising crime rate in the province (SAPS Annual Crime Report, 2019) means that burnt remains will likely continue to be an issue and is an area where anthropological input will be needed.

In terms of PMI estimations, another factor that may have impacted precision is the general lack of regional PMI standards. Regional data is important in PMI estimations due to the significant effect of local environmental conditions, such as sun exposure, rainfall,

temperature, climate and the access of insects or scavengers (Sutherland *et al.* 2013). The WC province is one of the most unique biodiversity ecosystems in the world with Cape Town located within the Cape Floral biome which is a biodiversity hotspot home to 19 distinct vegetation types (City of Cape Town Biodiversity Report, 2008). The WC is also climatologically varied, with numerous distinct micro- and macroclimates resulting from the varied topography and influence of the surrounding ocean currents (Branch and Branch, 1981; Tyson and Preston-Whyte, 2001). To date, most decomposition studies in the WC province have been conducted in Cape Town, in the thicketed Cape Flats Dune Strandveld habitat (Spies *et al.* 2018a; 2018b; Finaughty, 2019; Forbes, 2019; Spies *et al.* 2020). This region has police precincts with high population densities and high murder rates. The results of this study showed that just less than half of the decedents were discovered in sparsely populated areas (47%; 81/174) popular for recreational activities (Table 3.2). The most common sites of discovery included vegetated areas, the roadside, aquatic environments and farming areas (Figure 3.4A). Forensic taphonomy research should therefore also be conducted in these areas to generate specific decomposition rates.

The associated physical evidence discovered with an individual can be useful in the estimation of the PMI. In this study, clothing and associated physical evidence were recovered with 58% (100/174) and 42% (73/174) of the decedents respectively. Associated physical evidence, such as dated documents can also be used to estimate the PMI. The degradation state of clothing and the lipid profile of the decomposed remains retained by the clothing can be used in the estimation of PMI (Ueland *et al.* 2019). Spies *et al.* (2020) identified that most decedents examined by FACT wore cotton-type clothing. Future research could therefore generate local PMI standards considering the influence of clothing in the aforementioned locations or areas or with a focus on fabric degradation of clothing types or lipid profiles from the clothing.

A considerable number of decedents in this study were missing most of their skeleton (32%; 54/174) or fragmented (31%; 60/174). This was generally related to the reported post-mortem damage, including scattering by scavenging by animals or human action via dismemberments; the methods of disposal such as multilevel burials or the complexity of the terrain they were discovered, for example burials on a slope can move down over time. Generally, law enforcement officers are not trained in archaeological principles and techniques needed for these types of excavations. Therefore, these findings emphasise the importance of full skeletal recovery.

Full skeletal recovery and little or no fragmentation on the skeleton are important as these have implications for the estimation of the biological profile. In this study, sex estimations were indeterminate for 5% (9/174) of decedents and 25% (44/174) were indeterminate for ancestry. Ancestry estimations were impeded by the absence (6%; 10/174) or fragmentation of the cranium (n = 34). In addition, the absence of some skeletal resulted in an inability to assign 17% (29/174) of adult decedents into more specific age ranges.

4.2.2 Reported demographics

Case demographics were analysed to determine the populations represented in FACT cases. This was done to identify if there are populations that are most at risk of being unidentified persons in need of anthropological analysis in the WC province. In this study, there was a clear predominance of male (67%; 116/174) over female (28%; 49/174), with the middle – old-aged adults (> 35 years) accounting for more than half of all cases (54%; 94/174). The sexual composition of FACT cases was in accordance with observations from other forensic anthropology laboratories, wherein men represented the majority of decedents (İşcan and Olivera, 2000; Grisbaum and Ubelaker, 2001; Komar, 2003; Vaz and Benfica, 2008; Evison *et al.* 2012; Steyn *et al.* 1997; 2016; Parsons, 2016; Steyn *et al.* 2016). The age bias toward middle to older adults observed in this study was inconsistent with international trends which showed that most decedents were generally young to middle-aged adults (Grisbaum and Ubelaker, 2001; Vaz and Benfica, 2008; Evison *et al.* 2012) or older adults (İşcan and Olivera, 2000).

The ancestral composition in this study showed that most of the decedents were of Mixed (37%; 65/174) or African ancestry (22%; 39/174) and was inconsistent with international trends (Grisbaum and Ubelaker, 2001; Evison *et al.* 2012; Parsons, 2016) where decedents were mainly white, and observations made by Steyn *et al.* (1997) who reported that most individuals in their study were black South Africans. These data (*i.e.,* the ancestral composition in this study) were a reflection of the demographic composition of the WC province.

The disparities in the demographics reported in this study and those conducted at other forensic anthropology laboratories can be attributed to differences in regional demographics, crime and murder rates and socio-economic status, highlighting the importance of regionally specific studies (Evison *et al.* 2012). While the FACT case demographics represent a subset of anthropologically analysed decedents in the WC province, these findings provide a local population perspective pertaining to the phenomenon of unidentified bodies.

4.2.3 Trauma & pathological conditions with demographics and case localities

The association between reported demographics with trauma and pathological conditions was assessed to identify the circumstances around the deaths of the decedents analysed by FACT. Additionally, these conditions could also be informative about the lived experiences of the decedents, as they provide information regarding their health or habits. The findings related to trauma (both ante- and peri-mortem trauma) showed that most decedents did not sustain injuries. Ante- and peri-mortem injuries were observed in 41% (72/174) and 29% (50/174) decedents respectively. These results may be an indication that the deaths of many decedents did not involve foul play and that they did not experience much violence in their lifetimes; however, even in cases involving violent assaults, injuries are not always apparent on the bones. In the cases where trauma was observed, sharp and blunt forces, gunshots or burning were the most common causative mechanisms. These were consistent with the type of injuries that would result from weapons such as knives, firearms, bricks, stones/rocks or bottle/bottle heads; weapons that were noted as the most commonly used to commit murder in the country (SAPS Annual Crime Statistics, 2019). The mechanisms observed in this study were generally similar to those at other forensic anthropology laboratories (Steyn *et al*. 1997; Grisbaum and Ubelaker, 2001; Vaz and Benfica, 2008; Evison *et al.* 2012; Steyn *et al*. 2016).

The high rates of trauma observed in this study were also a reflection of the areas the decedents were discovered and the methods of disposal. Approximately half of individuals in this study were discovered in high crime areas, mainly in Cape Town. The City of Cape Town has the highest population density and murder rate in the province. Cape Town houses approximately 4 million of the 6.8 million individuals in the WC province (Statistics South Africa, 2016). The city has the highest murder rate in the country, with six of its police stations in the top ten in terms of murders in the country (WC Government, 2019) and all these police stations referred multiple cases to FACT. The large volumes of unidentified bodies coming from high murder rate areas are often attributed to the low socio-economic standing of most of the population, gang violence, drug trades or high population densities (Evert, 2012; Baliso *et al.* 2019; WC Government, 2019).

Regarding the relationship between reported demographics with trauma, the results of this study showed that the most significant factor contributing to the likelihood of a decedent presenting with ante-mortem trauma was being a middle – old-aged adult man, regardless of

ancestry, while for peri-mortem trauma it was being of African or European ancestry, regardless of sex or age. No clear explanation exists for the high prevalence of peri-mortem injuries in individuals of European and African ancestry. The results also indicated that certain age-groups were more likely to present with ante-trauma, as young adults and juveniles were the most likely to present with peri-mortem trauma. Similar to the reported demographics data, these findings provide a local population perspective pertaining to the occurrence of trauma in the population of anthropologically analysed decedents.

Pathological conditions were observed in most decedents (69%; 120/174), with most presenting with multiple conditions. The high prevalence of pathological conditions was related to the overrepresentation of the middle – old-aged adults in FACT cases. The high prevalence of these conditions in this age group is due to the incidence of some pathological conditions increasing with age, as some of these conditions affect people after forty and gradually worsening over time (Cunha and Pinheiro, 2013). The high prevalence of pathological conditions could also be attributed to South Africa's poor healthcare services. The most commonly observed pathologies were due to poor dental care or hygiene, ageing, trauma or stress to the skeleton. Due to the failure of South African health care institutions to meet basic standards of care and patient expectations, many patients forgo medical treatment (National Department of Health, 2012). Therefore, many conditions or diseases generally go untreated and may have contributed to deaths of some the decedents.

4.3 CASE OUTCOMES AND RATES OF POSITIVE IDENTIFICATION

4.3.1 Case outcomes

In the context of criminal investigations, for forensic anthropology to be considered effective, it should contribute to the identification of decedents and the resolution of police investigations. The analyses of police case outcomes, positive identifications and the accuracy of the demographic profiles were precluded by a lack of feedback from authorities once affidavits were submitted. In this study, the outcomes of many police investigations of FACT cases were unknown (23%; 39/172) as was the information regarding whether decedents were identified or not (14%; 23/168). For some identified decedents ante-mortem demographic information was lacking or difficult to obtain and thus, comparisons were not possible. The lack of feedback from law enforcement was consistent with experiences of forensic anthropologists at Smithsonian (Grisbaum and Ubelaker, 2001), SMLC, CEMEL (Evison *et al.* 2012) and FARC

(Steyn *et al.* 2016). These findings show that there are communication and/or visibility issues between and within stakeholders.

The assessment of police case outcomes is further compounded by the challenges in interpreting their case status. Although a considerable number of cases were closed by the police (49%, 85/172), it was evident that the positive identification of a decedent was not a prerequisite. For 52% (44/84) of unidentified decedents, the cases were classified as closed by the police. This means that these cases are unresolved, pending the discovery of new evidence. Case resolution could also be impacted by the court system. In South Africa, the court system is generally slow, with frequent postponements. As a result, FACT members rarely testified in court, having done so in only nine occasions. However, the lack of court appearances for FACT members may also be due forensic pathologists incorporating all or some of the information on the FACT affidavit into their own affidavit. Generally, FACT members and forensic pathologists have an understanding that their anthropological findings could form part of the pathologist's affidavit.

4.3.2 Rates of positive identification

Positive identification can be accomplished in a number of ways. In cases involving decomposed, skeletonised or burnt human remains it usually involves obtaining a demographic profile of the deceased from their skeleton using anthropological techniques and matching the information with their ante-mortem records. The identification of unknown persons is of great importance, not only for the families of the decedent to get closure but also for the successful resolution of police investigations (Simmons and Haglund, 2005; Krysztofiak, 2017). The results of this study showed that 37% (61/168) reached a positive identification and 49% (84/168) were unidentified.

The rate of positive identification observed in this study was slightly higher than the rates reported at Montevideo (İşcan and Olivera, 2000) and Porto Alegre (Vaz and Benfica, 2008), which were 25% and 26% respectively. In this study, the most significant factor contributing to the likelihood of a decedent being identified was the presence of a probable identity The presence of a probable identity was reported for 41 decedents and 81% (33/41) of them reached a positive identification. The presence of a probable identity for these decedents may have meant that the police did not need to go through thousands of missing persons records to find

a match. Additionally, a probable identity may have enabled identification even in cases where the individual was not reported missing as the police would have had a point of reference.

Nevertheless, it cannot be disregarded that a considerable number of decedents in this study did not reach a positive identification (49%; 84/168). The inability to identify unknown decedents creates numerous consequences for the deceased individual, their relatives and society. Recall that in South Africa, unidentified or unclaimed persons are buried *en masse* often with four per grave or cremated (Naidoo, 2007; Evert, 2012). The decedents are buried with no one there to mourn them and their families cannot get closure. In this study, thirty unidentified decedents were buried as paupers by the state. Pauper burials were also performed for nine positively identified decedents who were unclaimed at the mortuary. These decedents were probably from families of low socio-economic status who were unable to afford funeral costs; or they were identified through the Local Criminal Record Centre, but the individual had no next-of-kin or formal address on record or they gave a false identity when first arrested and so no relatives could be located.

Other unidentified or unclaimed decedents were donated to UCT. In South Africa, the Human Tissue Act 65 of 1983 permits for the Inspector of Anatomy to donate unidentified or unclaimed bodies to specified institutions, to be used for research and teaching purposes. The donation of unidentified bodies poses an ethical dilemma, as there is no informed consent and thus autonomy is absent. Consideration is not given to the fact that such practices might be against decedents' cultures or beliefs, and that neither the deceased nor their families would consent to anatomical dissections. Given these consequences, the investigation of the potential reasons related to the anthropological analysis of why some decedents were identified and others remained unidentified is of great importance.

There are multiple reasons an individual may remain unidentified, including but not limited to the individual not being reported missing, the biological evidence (DNA, biological profile) has yet to confirm the identity or the decedent being an undocumented immigrant or a South African citizen with no formal identification. It may not be possible to know exactly why a decedent remains unidentified, however, the analysis of the anthropological affidavits can provide some insight.

One of the factors noticeable among the affidavits was the effect of the number of skeletal elements present for anthropological analysis. Since the degree of completeness of the body influenced the estimation of the biological profile, consequently, identification was also

affected (Komar and Potter, 2007). There was a general decrease in the rate of positive identification when less skeletal material was available for analysis. The inability to estimate some of the demographics and lack of specificity of estimations may have done little to narrow down the pool of missing persons the decedent could potentially be, thus, hindering identification.

Individuals of European and African ancestry had higher rates of identification compared to those of Mixed ancestry. No clear explanation for the higher rates of identification of these decedents could be deduced from the data in this study. Further investigation of these results may be needed, however, considering the small sample size in this study these results may be just random. There was also a general decrease in the identification rate with an increase in age. In addition, the rate of positive identification for decedents whose sex was indeterminate was higher than those who had an estimated sex. Recall, that decedents with indeterminate sex were mostly juveniles. This higher rate of identification for younger individuals could be due to these cases given more attention by communities, families, authorities or the media as they are considered vulnerable (Kiepal *et al.* 2012; Taylor *et al.* 2013). The results of this study may only highlight the potential factors related to forensic anthropological analysis as to why some decedents remained unidentified and other were identified. Nonetheless, these data serve as a reminder that the identification of unknown persons is the responsibility of many stakeholders, including families, law enforcement, the media and other interested parties as well forensic investigators (Parsons, 2017).

The lack of precision of the interpretation of taphonomic changes and PMI estimations may have also impacted the identification of decedents. Accurate PMI estimations are of great importance to case resolution and identification as it can narrow the pool of possible decedents (Sutherland *et al.* 2013) or supporting witness testimony or confirming alibis (Megyesi *et al.* 2005). The findings of this study highlighted common areas and contexts for the discovery of decomposed bodies in the WC province. Thus, they should be used to guide forensic taphonomy research to better understand local decomposition rates that incorporate the influence and investigation of clothing. Generating more accurate PMI standards for the different regions in the WC province could contribute significantly to positive identification and case resolution.

Despite several decedents in this study presenting with ante-mortem trauma (41%; 72/174), these features aided in the identification of only two decedents. This was due to ante-mortem medical records being absent or difficult to obtain. For both decedents, the observed ante-

mortem injuries were matched to information provided by families to the police. The contribution and value of ante-mortem injuries in identification has also been described in other studies, who also noted the lack of medical records for comparisons (Grisbaum and Ubelaker, 2001; Vaz and Benfica, 2008). The lack of medical records for comparisons is unfortunate considering how rapid, reliable and inexpensive it is as a technique for identification (Vaz and Benfica, 2008). These findings suggest that for the resolution of cases involving decomposed bodies the police should routinely collect information about past injuries and unique anatomical features to match with the evidence that may be gathered from a post-mortem investigation.

In section 1.1, it was discussed that the identification of unknown decedents was the mandate of the SAPS, assisted by FPS (The National Health Act 61 of 2003). Therefore, identification rates were analysed by the FPS facilities they were referred from to assess whether the caseloads experienced by these agencies affected the identification of individuals. It could be hypothesised that the mortuaries with fewer admissions would have higher identification rates due to these mortuaries serving smaller catchment areas, that generally have low population densities, less crime/murders and lower influxes of migrants. SRM and Tygerberg, two of the busiest mortuaries in the province had higher identification rates than most facilities with fewer caseloads. However, both had lower identification rates than Worcester and Vredendal, which have fewer cases annually (Table 3.7). These results suggest that heavy caseloads or busyness, as well as the high crime rates, population densities and migrant inflows in these catchment areas may not hinder the chances of a decedent being identified.

As discussed in section 1.1, migratory flows, both internally and from other countries have been considered one of the biggest contributors to the phenomenon of unidentified bodies worldwide (Cattaneo *et al.* 2010; Parsons, 2016; Yadav *et al.* 2017). In this study, nine of the positively identified decedents were identified as potential circular labour migrants (eight from the Eastern Cape province and one from the Northern Cape province). Every year, the City of Cape Town experiences a large inflow of migrants (Shiel, 2014; Statistic South Africa, 2019). Many people from different provinces throng to the city in search of employment. These decedents tend to have loose social ties which makes it difficult to track down their next-of-kin and relatives (Naidoo, 2007; Yadav *et al.* 2017). None of the identified decedents were illegal immigrants as all three of the individuals determined to be foreign internationals were in the country legally. These findings indicate that the phenomenon of unidentified decedents

(in need of anthropological analyses) is a reality affecting the local population that could be partially exacerbated by cross border migration (legal or illegal).

Another population thought to contribute significantly to the phenomenon of unidentified decedents are indigent people (Paulozzi *et al.* 2008; Chattopadhyay *et al.* 2013; Yadav *et al.* 2017). These decedents tend to make up a significant proportion of decomposed cases due to their isolation as well as loose social ties (Kiepal *et al.* 2012). In this study, five decedents were discovered in what seemed like outdoor man-made living areas, suggesting they may have been homeless. Only one of these individuals was positively identified. An estimated 4 862 homeless people live in the City of Cape Town area and about 700 live in the central business district (CBD) (WC Government, 2019). Thus, it is imperative that measures be taken to monitor these populations and the areas they may frequent.

4.3.3 The accuracy of reported demographics

Positive identification could also have been affected by the inaccuracy of the demographic estimations provided by FACT. Inaccurate estimations may have impeded identification by misdirecting police searches or unintentionally excluding the decedent from the pool of possible matches. The estimation of sex is one of the first and most important pieces of information required for the development of a biological profile. An accurate sex estimation has the potential to narrow the pool of possible decedents in half and can influence the estimations of all other demographic variables (*i.e.,* ancestry, age, and stature).

In this study the accuracy rate of sex estimations was 98% (48/49). This was slightly higher than the 94.7% accuracy rate observed by Thomas *et al.* (2016) and slightly lower than the 100% accuracy rate reported by Parsons (2016). The misclassified decedent in this study was the only one (of the 49) who did not have a cranium present. Once more, these data highlight the importance of full skeletal recovery. Additionally, these findings may indicate that it is the morphological traits of the cranium that best distinguishes between males and females in South African populations using FACT's current techniques. This is also supported by the fact that decedents (n = 3) who only had a cranium present were correctly classified. The pelvis has long been recognised as the best way to distinguish between the sexes due to hormonally driven skeletal markers and reproductive requirements and thus, future studies are needed to investigate the validity of the findings of this current study.

Age-at-death estimations documented in this study were 80% (41/51) accurate. This accuracy rate was slightly lower than that reported by Parsons (2016) of 89%. This may be attributed to most of the methods utilised in age-at-death estimations being developed using American populations, where the Parsons (2016) study was conducted. In this study, the incorrect age-at-death estimations could be attributed to pathological conditions. In general, overestimated decedents had evidence of skeletal degeneration indicative of an older age range while those who were underestimated generally did not present with degenerative morphological changes often observed in individuals of their actual age range. Some pathological conditions tend to occur past a certain age or worsen as age increases (Cunha and Pinheiro, 2013). Therefore, when these conditions are observed on the skeleton forensic anthropologists could infer that the decedent is of that age range. However, pathological conditions are also influenced by environmental and genetic factors therefore, impacting the precision of age-at-death estimations (Berg, 2008). Furthermore, some pathological conditions can affect the features used for age-at-death estimation due to their effect on bone growth or morphology (Bertrand *et al.* 2016). Considering that many decedents in this study presented with pathological conditions, it is possible that the age-at-death estimations for numerous decedents were erroneous, which could have hindered their identification. The findings suggest that there is a need for basic research locally on the effect of pathological conditions on age-at-death estimations.

Ancestry estimations were accurate for 84% (32/38) decedents. This was lower than the 91% accuracy rate observed by Thomas *et al.* (2017) and the 99% accuracy rate reported by Parsons (2016). In this study, the incorrect estimations mostly involved individuals of Mixed ancestry being misclassified as being of African ancestry (and vice versa). The results of this study showed that seventeen decedents were estimated to be either of Mixed or African ancestry, suggesting that there were challenges in detecting population-level human biological variation between these populations. The historical origins of these populations both being primarily from Africa is why they may be difficult to distinguish. Research has indicated that individuals of Mixed and African ancestry tend to be similar in terms of shape (McDowell *et al.* 2015; Krüger *et al.* 2018). These findings suggest that techniques utilised by FACT may not be a valid measure of detecting biological variation between individuals of African and Mixed Ancestry. Future research may be required to generate techniques that can distinguish these populations if ancestry estimations are to be continued (Patterson *et al.* 2010; Montinaro *et al.* 2017).

Other factors possibly contributing to the incorrect ancestry estimations could the disconnect between race and ancestry. Social racial categories do not necessarily conform to the distinct broad biological, genetic and geographical ancestral origins meaning that the race an individual identifies with or is identified as may not necessarily be related to their biological ancestry. The fragmentation of some of the crania could have also contributed to erroneous ancestry estimations. Considering that there are challenges detecting biological variation between individuals of African and Mixed Ancestry, estimating the decedent as exclusively either one could have impacted their identification by excluding the individual from being a possible match. Additionally, the disconnect between social race categories and ancestry could have excluded the person as a possible match even if the estimation was correct. These findings raise the question of whether or not ancestry should be estimated in South Africa.

The accuracy rate of stature estimations was 100% (4/4). Stature accuracy rates were impacted by the lack of or difficult obtaining ante-mortem height information. The lack of these data could indicate that stature may not be a crucial piece of information in the identification of missing and unidentified persons. If FACT will continue with stature estimations, perhaps it would be more useful in the identification of individuals in the extreme ends of the stature spectrum, rather than being a distinguishing feature.

Despite many of the methodologies utilised by FACT to estimate demographics having been developed in international populations, where comparisons could be made, the estimations were still highly accurate. The estimation of demographic variables is multifaceted and dependent on the preservation or availability of skeletal elements required for estimation, the practitioner's education level and observation error or the application of the method or instrument (Parsons, 2017). Thus, these findings provide insight into the overall accuracy rates of biological profile estimations by FACT in local forensic casework.

4.4 STUDY LIMITATIONS

Due to the lack of feedback from authorities, information pertaining to police case outcomes or whether decedents were identified or not was lacking. Additionally, the ante-mortem records of the positively identified decedents was either lacking or difficult to obtain. Police case outcomes were unknown in 23% (39/172) of cases and for 14% (23/168) information about positive identification was unavailable. Although 37% (61/168) reached a positive identification, ante-mortem demographic information was not available for all of them,

especially living stature records. These impacted the number of comparisons that could be made reducing the robustness of the results or conclusions observed in this study. Furthermore, it was not possible to ascertain the method used to identify the decedents, *i.e.*, whether it was due to the forensic anthropological findings or DNA comparisons. This information would have added value to this research in the assessment of the direct impact of FACT. This is important in the consideration of legislating forensic anthropology in the country and possibility of hiring practitioners in law enforcement or mortuaries. Other limiting factors included the incomplete FACT affidavits and/or records (*e.g.*, missing information regarding dates of examination or places of discovery) which impacted data analyses.

One of the objectives of this study was to obtain information regarding the number of decomposed, skeletonised or burnt individuals admitted to each mortuary. These data would have been used to assess whether FACT was consulted on all decomposed, burnt or skeletonised cases from each FPS facility. In addition, the data would be used to examine if FACT consultation led to more positive identifications. However, due to factors including excessive caseloads faced by the FPS facilities and the availability of FACT members to follow-up with each facility (as a reminder to gather the data), these data could not be obtained. Considering that data from Reid *et al.* (2020) revealed that SRM received more than six times the number of cases referred to FACT during the same time period, the implication is that FACT cases reflect only a subset of unidentified decedents (in need of anthropological cases) in the WC province and is not representative of all cases in the region.

4.5 FUTURE RECOMMENDATIONS

It is recommended that a follow up on the data pertaining to the number of decomposed, skeletonised or burnt individuals admitted to each mortuary still be conducted. These data may provide valuable information on the extent of the need of forensic anthropology in the province and the utilisation of the discipline in the province. Furthermore, the data could provide insight into whether the service is actually needed. If decomposed cases examined by FACT have higher resolution and positive identification rates than those analysed by forensic pathologists, that may suggest that forensic anthropologists are more equipped to handle such cases. Additionally, future studies could evaluate whether the results of the anthropological analysis led to the identification or were used in any way during the course of the investigation. This

may assist in highlighting the need for the legislation of forensic anthropology in forensic casework.

Future studies may expand on this research by using it to identify the gaps that exist in the discipline of forensic anthropology and directing research to resolve these issues. One of the issues observed in this study were challenges in detecting population-level biological variation between individuals of African and Mixed ancestry, mainly attributed to both these populations being primarily of African descent, meaning they have the same geographical ancestral origins and likely share biological and genetic ancestral origins. Future studies can investigate this issue further and possibly generate new methodology and techniques capable of distinguishing between these populations. In addition, the results highlighted a number of things such as hotspots for the discovery of bodies (such as Table Mountain National Park) or the populations most likely to be brought in for FACT analysis. These findings may be used to guide future forensic taphonomic research to better understand local decomposition rates. Another study could utilise contained the GPS co-ordinates of where decedents were discovered contained in the FACT database to identify more precisely the areas where bodies were found instead of the broad localities identified through the police stations in this study.

CONCLUSION

This study retrospectively examined all FACT cases referred from FPS facilities in the WC province between 2006 and 2018. The aim was to assess the impact of FACT on the identification of unknown decedents and police case resolutions in the WC province. Additionally, the profile of the anthropologically analysed decedents was examined to identify any informative patterns that may aid in decreasing the number of unidentified deaths.

The FACT laboratory received a wide variety of cases from the FPS during the study period (2006 – 2018). FACT provided many services including scene recovery, distinguishing forensic from non-forensic cases, providing a demographic profile of the deceased, and interpretations of trauma, among others. The need for anthropological input in the WC province is evident, due to the wealth of archaeological sites and the large number of decomposed or burnt bodies entering mortuaries (Reid *et al.* 2020). However, this study showed that FACT services are underutilised in the WC province, as they were not consulted on all anthropological cases or scene recovery, and consultations were significantly delayed.

The underutilisation of FACT was mainly attributed to the discretion of the forensic pathologists (if they knew of FACT or wanted to consult) or lack of resources, with the availability of FACT members also being a factor. The presence of a full-time manager at FACT, who worked closely with other stakeholders, seemed to have resulted in more consultations as referrals peaked when the position was in effect. These findings suggested that having good communication channels between stakeholders is necessary for the effective use of anthropological input in casework. Moreover, for anthropological input to function effectively in local casework, the legislation of the field is needed, and it may be necessary for forensic anthropologists to be hired within South African mortuaries to assist directly in such cases (or at the very least, the busiest facilities).

The locality of cases was commonly in high crime rate areas in the Cape Town Metropole and sparsely populated suburbs, seaside towns or rural areas such as Table Mountain National Park. These common areas and contexts for the discovery of decomposed bodies should be used to guide forensic taphonomy research to better understand local decomposition rates and generate regionally specific PMI standards that incorporate the influence and investigation of clothing.

Decedents were predominately men (67%; 116/174) and adults older than 35 years (54%; 94/174). Individuals were of mostly of Mixed ancestry (37%; 65/174) or African ancestry

(22%; 39/174), with seventeen decedents estimated as being either one. Only 3% (6/174) were of decedents were of European ancestry. The demographic profile of FACT cases provided a baseline local population perspective pertaining to the phenomenon of unidentified bodies.

Ante- and peri-mortem injuries were observed in 41% (72/174) and 29% (50/174) decedents, respectively. The trauma observed in decedents in this study was a reflection of the high crime areas these decedents were found. Ante-mortem injuries were important for identification and aided in the identification of two individuals. Considering that many decedents in this study presented with ante-mortem injuries, they could have played a substantial role in identification had medical records been available for comparisons. These findings suggest that the police may need to routinely collect information about ante-mortem injuries or unique anatomical features in missing persons reports to facilitate identification.

The assessments of police case outcomes, positive identifications and accuracy demographic estimations were hindered by a lack of or difficulty in obtaining the relevant information from the police or FPS facilities. This was mainly attributed to poor communication between stakeholders. The accuracy of sex estimations was affected by the absence of key skeletal elements; the correctness of age-at-death estimations was affected by pathological conditions being present or absent or their effect on bone morphology; and the accuracy of ancestry estimations was impacted by the homogeneity of the South African population specifically, those of Mixed and African ancestry. These findings all warrant further investigation. Nonetheless, the demographic estimations in this study still showed a high level of accuracy where it could be evaluated, the implication being that the techniques employed by FACT perform well in local forensic casework and FACT is assisting with social and criminal justice.

DISCLOSURE OF CONFLICT OF INTEREST

Associate Professor Gibbon and Ms Baliso are members of FACT.

REFERENCES

Anderson BE. 2008. Identifying the dead: Methods utilized by the Pima County (Arizona) office of the medical examiner for undocumented border crossers: 2001-2006. *Journal of Forensic Sciences* **53**(1): 8-15.

Association for Savings and Investment South Africa 2018. Life insurers report a spike in fraudulent death claims for 2017. [online]. Available at: https://www.asisa.org.za/media/0ovdzqsr/20181212_life-insurers-report-a-spike-in-fraudulent-death-claims-for-2017.pdf [Accessed 6 Oct. 2020].

Baliso A, Finaughty C. and Gibbon VE. 2019. Identification of the deceased: Use of forensic anthropology at Cape Town's busiest medico-legal laboratory. *Forensic Science International: Reports* **1**: 100042.

Bax P. 2018. Forensic scientists battle to identify South Africa's dead: An extraordinarily large number of unidentified bodies passes through the country's mortuaries. [online] Bloomberg.com. Available at: https://www.bloomberg.com/news/features/2018-10-31/forensic-scientists-battle-to-identify-south-africa-s-dead [Accessed 8 Oct. 2020].

Berg G. 2008. Pubic bone age estimation in adult women. *Journal of Forensic Sciences* **53**(3): 569-577.

Bertrand B, Robbins-Schug G, Polet C, Naji S. and Colard T. 2016. Age-at-death estimation of pathological individuals: A complementary approach using teeth cementum annulations. *International Journal of Paleopathology* **15**: 120-127.

Blau S. and Briggs C. 2011. The role of forensic anthropology in Disaster Victim Identification (DVI). *Forensic Science International* **205**(1-3): 29-35.

Borić I, Ljubković J. and Sutlović D. 2011. Discovering the 60 years old secret: Identification of the World War II mass grave victims from the island of Daksa near Dubrovnik, Croatia. *Croatian Medical Journal* **52**(3): 327-335.

Brady L, De Vries S, Gallow R, George A, Gilson L, Louw M, Martin A, Shamis K. and Stuart T. 2019. Paramedics, poetry, and film: Health policy and systems research at the intersection of theory, art, and practice. *Human Resources for Health* **17**(1).

Branch M. and Branch G. 1981. *The Living Shores of Southern Africa*. Struik Publishers. Cape Town.

Buckberry J. and Chamberlain A. 2002. Age estimation from the auricular surface of the ilium: A revised method. *American Journal of Physical Anthropology* **119**(3): 231–239.

Buikstra JE. and Ubelaker DH. 1994. Standards for data collection from human skeletal remains. *Arkansas Archeological Survey* **44**: 272.

Cavard S, Alvarez J, De Mazancourt P, Tilotta F, Brousseau P, de la Grandmaison G. and Charlier P. 2011. Forensic and police identification of "X" bodies. A 6-years French experience. *Forensic Science International* **204**(1-3): 39-143.

Cattaneo C, Porta D, De Angelis D, Gibelli D, Poppa P. and Grandi M. 2010. Unidentified bodies and human remains: An Italian glimpse through a European problem. *Forensic Science International* **195**(1-3): 167.e1-167.e6.

Chattopadhyay S, Shee B. and Sukul B. 2013. Unidentified bodies in autopsy – A disaster in disguise. *Egyptian Journal of Forensic Sciences* **3**(4): 112-115.

Crimestatssa.com. 2018. Crime Stats SA - Crime Stats Simplified. [online] Available at: http://www.crimestatssa.com/province.php?ShowProvince=Western+. [Accessed 7 Oct. 2020].

Cunha E. and Pinheiro J. 2013. Bone pathology and antemortem trauma. *Encyclopedia of Forensic Sciences* 76-82.

De Jong J. 2017. *Investigating the effectiveness and efficiency of forensic pathology practice in Western Cape, South Africa*. Master's Thesis. University of Cape Town. South Africa.

De Wit E, Delport W, Rugamika C, Meintjes A, Möller M, van Helden P, Seoighe C. and Hoal E. 2010. Genome-wide analysis of the structure of the South African Coloured Population in the Western Cape. *Human Genetics* **128**(2): 145-153.

Donson H. 2009. *A profile of fatal injuries in South Africa 2008*. MRC-UNISA Crime, Violence & Injury Lead Programme.

Emser M. and van der Watt M. 2019. #Stillnotfound: Missing children in South Africa. *Alternation: Interdisciplinary Journal for the Study of the Arts and Humanities in Southern Africa* **26**(1): 89 - 120

Esan TA. and Schepartz LA. 2018. The Wits atlas: A Black southern African dental atlas for permanent tooth formation and emergence. *American Journal of Physical Anthropology* 1-11.

Evert L. 2012. *Unidentified bodies in forensic pathology practice in South Africa: Demographic and medico-legal perspectives*. PhD Thesis. University of Pretoria. South Africa.

Evison M, Francisco R. and Guimarães M. 2012. Approaching utility in forensic anthropology. *Forensic Science Policy & Management: An International Journal* **3**(2): 85-104.

Finaughty D. 2019. *The establishment of baseline data on the rates and processes of soft tissue decomposition in two terrestrial habitats of the Western Cape, South Africa*. PhD Thesis. University of Cape Town. South Africa.

Finaughty D. and Morris A. 2019. Precocious natural mummification in a temperate climate (Western Cape, South Africa). *Forensic Science International* **303**: 109948.

Forbes M, Finaughty D, Miles K. and Gibbon VE. 2019. Inaccuracy of accumulated degree day models for estimating terrestrial post-mortem intervals in Cape Town, South Africa. *Forensic Science International* **296**: 67-73.

Gordon I. and Drennan MR. 1948. Medico-legal aspects of the Wolkersdorfer case. *South African Medical Journal* **22**: 543–549

Grisbaum G. and Ubelaker DH. 2001. Analysis of forensic anthropology cases submitted to the Smithsonian Institution by the Federal Bureau of Investigation from 1962 to 1994. *Smithsonian Contributions to Anthropology* **45**: 1-15.

Hanzlick R. and Smith G. 2006. Identification of the unidentified deceased. *The American Journal of Forensic Medicine and Pathology* **27**(1): 79-84.

Head T. 2019. Visit Table Mountain at your own risk': Safety group let fly after tourist killed. [online] The South African. Available at: https://www.thesouthafrican.com/news/table-mountain-tourist-killed-safety-risks/ [Accessed 8 Oct. 2020].

İşcan YM, Loth S. and Wright R. 1985. Age estimation from the rib by phase analysis: White females. *Journal of Forensic Science* **30**(3): 11018J.

İşcan YM. 1988. Rise of forensic anthropology. *American Journal of Physical Anthropology* **31**(9): 203-229.

İşcan YM, Loth S. and Wright R. 1993. *Casts of age phases from sternal rib ends for white males and females*. France Casting. Bellvue, Colorado.

İşcan YM. and Olivera H. 2000. Forensic anthropology in Latin America. *Forensic Science International* **109**(1): 15-30.

İşcan YM. and Steyn M. 2013. *The Human Skeleton In Forensic Medicine*. CC Thomas. Springfield, Illinois.

Iwamura ESM, Soares-Vieira JA. and Muñoz DR. 2004. Human identification and analysis of DNA in bones. *Revista do Hospital das Clínicas* **59**: 383–88.

Kiepal L, Carrington PJ. and Dawson M. 2012. Missing persons and social exclusion. *Canadian Journal of Sociology* **37**(2): 137-168.

Kimemia D. and Van Niekerk A. 2017. Energy poverty, shack fires and childhood burns. *South African Medical Journal* **107**(4): 289.

Kok P, Collinson M, Tonder L, Roux N. and Garenne M. 2006. Migration and urbanization in South Africa. [online] Available at: https://www.researchgate.net/publication/236144246_Migration_and_urbanization_in_South_Africa [Accessed 14 Nov. 2020].

Komar DA. 2003. Twenty-seven years of forensic anthropology casework in New Mexico. *Journal Forensic Science* **48**(3): 521–4.

Komar DA. and Potter W. 2007. Percentage of body recovered and its effect on identification rates and cause and manner of death determination. *Journal of Forensic Sciences* **52**(3): 528-531.

Komar DA. And Buikstra JE. 2008. *Forensic Anthropology: Contemporary Theory And Practice*. Oxford University press. Oxford.

Kranioti EF. and Paine RR. 2011. Forensic anthropology in Europe: An assessment of current status and application. *Journal of Anthropological Sciences* **89**: 71-92

Kriegler A. and Shaw M. 2016. *A Citizen's Guide To Crime Trends In South Africa*. Jonathan Ball Publishers. Johannesburg.

Krüger GC, Liebenberg L, Myburgh J, Meyer A, Oettlé AC, Botha D, Brits DM, Kenyhercz MW, Stull KE, Sutherland C and L'Abbé EN. 2018. Forensic anthropology and the biological profile in South Africa. *In New Perspectives in Forensic Human Skeletal Identification* 313–321.

Krysztofiak B. 2017. *DNA profiling of unidentified human remains in the South African context: An ethico-legal analysis*. Master's Thesis. University of the Witwatersrand. South Africa.

Kubheka A. 2020. Corpses pile up in KZN morgue crisis. [online] Available at: https://www.iol.co.za/dailynews/corpses-pile-up-in-kzn-morgue-crisis-18763844 [Accessed 7 October 2020].

Kumar A, Harish D, Singh A, Kulbhushan and Kumar G.A. 2014. Unknown dead bodies: Problems and solutions. *Journal of Indian Academy of Forensic Medicine* **36**: 76-80.

L'Abbé EN. and Steyn M. 2012. The establishment and advancement of forensic anthropology in South Africa. In: Dirkmaat, DC. (eds.) *A Companion to Forensic Anthropology*. Wiley-Blackwell, United Kingdom. pp. 626-638.

L'Abbé EN, Kenyhercz MW, Stull KE, Keough N. and Nawrocki S. 2013. Application of Fordisc 3.0 to explore differences among crania of North American and South African blacks and whites. *Journal of Forensic Science* **58**: 1579–1583.

Larsen CS. and Walker PL. 2005. The ethics of bioarchaeology. In: Turner, TR. (eds.). *Biological Anthropology and Ethics: From Repatriation to Genetic Identity*. State University of New York Press, New York. pp. 111-119.

Liebenberg L, Stull K, L'Abbé E. and Botha D. 2015. Evaluating the Accuracy of Cranial Indices in Ancestry Estimation Among South African Groups. *Journal of Forensic Sciences* **60**(5):1277-1282.

Lerer L. 1994. Homicide-associated burning in Cape Town, South Africa. *American Journal of Forensic Medicine and Pathology* **15**: 344–7.

Lerer LB. and Kugel C. 1998. Delays in the identification of non-natural mortality. *American Journal of Forensic Medicine and Pathology* **19**: 347-351.

Longden-Thurgood C. 2018. *Optimisation of DNA extraction from teeth submerged in False Bay, South Africa*. Master's Thesis. University of Cape Town. South Africa.

Lundy JK. and Feldesman MR. 1989. *The femur/stature ratio: A method to estimate living height from the femur*. Unpublished paper presented at the 41st Annual Meeting of the American Academy of Forensic Sciences, Las Vegas, Nevada. 13–18 February 1989.

Megyesi M, Nawrocki S. and Haskell N. 2005. Using accumulated degree-days to estimate the postmortem interval from decomposed human remains. *Journal of Forensic Sciences* **50**(3): 1-9.

Montinaro F, Busby GBJ, Gonzalez-Santos M, Oosthuitzen O, Oosthuitzen E, Anagnostou P, Destro-Bisol G, Pascali VL. and Capelli C. 2017. Complex ancient genetic structure and cultural transitions in Southern African populations. *Genetics 205* 303–316.

Morgan JM. 2011. *Proving genocide: The role of forensic anthropology in developing evidence to convict those responsible for genocide*. Master's Thesis. The Florida State University College of Arts and Sciences. United States of America.

Morris AG. 2011. *Missing & Murdered: A Personal Adventure In Forensic Anthropology*. Zebra Press. Cape Town.

Morris AG. 2014. Controversies about the study of human remains in post-Apartheid South Africa. In: O'Donnabjain, B and Lozada, MC. (eds.) *Archaeological Human Remains: Global Perspectives (SpringerBriefs in Archaeology)*. Springer International Publishing, New York City. pp. 189-198.

Mukhuthu Z. 2015. Pauper burials for unclaimed bodies. [online] Available at: https://www.dispatchlive.co.za/news/2015-11-18-pauper-burials-for-unclaimed-bodies/ [Accessed 7 October 2020].

Naidoo P. 2007. *The nature and scope of the problem of identifying unidentified bodies at medico-legal mortuaries in South Africa: A medico-legal perspective*. Master's Thesis. University of KwaZulu Natal.

Niekerk A, Reimers A. and Laflamme L. 2006. Area characteristics and determinants of hospitalised childhood burn injury: A study in the city of Cape Town. *Public Health* **120**(2): 115-124.

Nienaber WC. and Steyn M. 2002. Archaeology in the service of the community repatriation of the remains of Nontetha Bungu. *South African Archaeological Bulletin* **57**(176): 80–84 .

Norman R, Matzopoulos R, Groenewalda P. and Bradshawa D. 2007. The high burden of injuries in South Africa. *Bulletin of the World Health Organisation* **85**: 695–702.

Obertová Z, Adalian P, Baccino E, Cunha E, De Boer H, Fracasso T, Kranioti E, Lefévre P, Lynnerup N, Petaros A, Ross A, Steyn M. and Cattaneo C. 2019. The status of forensic

anthropology in Europe and South Africa: Results of the 2016 FASE questionnaire on forensic anthropology. *Journal of Forensic Sciences* **64**(4): 1017-1025.

Olze A, Van Niekerk P, Ishikawa T, Zhu BL, Schulz R, Madea H. and Schmeling A. 2007. Comparative study on the effect of ethnicity on wisdom tooth eruption. *International Journal of Legal Medicine* **121**: 445-448.

Parliamentary Monitoring Group. 2019. Impact of illegal migration on cities: Input from Joburg & Ekurhuleni mayors, SALGA & Minister | PMG. [online] Available at: https://pmg.org.za/committee-meeting/29125/ [Accessed 13 Oct. 2020].

Parsons HR. 2017. *The accuracy of the biological profile in casework: An analysis of forensic anthropology reports in three medical examiners offices.* PhD Thesis. University of Tennessee. United States of America.

Patterson N, Petersen DC, van der Ross RE, Sudoyo H, Glashoff RH, Marzuki S, Reich D. and Hayes VM. 2010. Genetic structure of a unique admixed population: Implications for medical research. *Human Molecular Genetics* **19**: 411–419

Paulozzi L, Cox C, Williams D. and Nolte K. 2008. John and Jane Doe: The epidemiology of unidentified decedents. *Journal of Forensic Sciences* **53**(4): 922-927.

Phenice T. 1969. A newly developed visual method of sexing the os pubis. *American Journal of Physical Anthropology* **30**(2): 297–301.

Pillay-van Wyk V, Msemburi W, Laubscher R, Dorrington R, Groenewald P, Glass T, Nojilana B, Joubert J, Matzopoulos R, Prinsloo M, Nannan N, Gwebushe N, Vos T, Somdyala N, Sithole N, Neethling I, Nicol E, Rossouw A. and Bradshaw D. 2016. Mortality trends and differentials in South Africa from 1997 to 2012: Second National Burden of Disease Study. *The Lancet Global Health* **4**(9): e642-e653.

Posel D. 2004. Have migration patterns in post-apartheid South Africa changed?. *Journal of Interdisciplinary Economics* **15**(3-4): 277-292.

Reid K, Martin L. and Heathfield L. 2020. Bodies without names: A retrospective review of unidentified decedents at Salt River Mortuary, Cape Town, South Africa, 2010 - 2017. *South African Medical Journal* **110**(3): 223.

Schaefer M, Black S. and Scheuer L. 2009. *Juvenile Osteology: A Laboratory And Field Manual*. Academic Press. London.

Schiel R. 2014. *Migrant labour in contemporary South Africa*. Master's Thesis. University of Cape Town. South Africa.

Sealy J, Maggs T, Jerardino A. and Kaplan J. 2004. Excavations at Melkbosstrand: Variability among herder sites on Table Bay, South Africa. *The South African Archaeological Bulletin* **59**(179): 17.

Simmons T. and Haglund WD. 2005. Anthropology in a forensic context. In: Hunter, J and Cox, M. (eds.) *Forensic Archaeology: Advances in Theory and Practice* Routledge, London. pp. 159–176.

Šlaus M, Strinović D, Pećina-Šlaus N, Brkić H, Baličević D, Petrovečki V and Pećina T. 2007. Identification and analysis of human remains recovered from wells from the 1991 War in Croatia. *Forensic Science International* **171**(1): 37-43.

Smith AB. 2015. Repatriation begins at home: Violence against South Africa's underclass, a colonial legacy that needs closure. In Mayor, A Négri, V and Huysecom, E. (eds.) *African Memory in Danger - Mémoire Africaine en Peril*. Africa Magna Verlag, Frankfurt pp. 52-60.

Smith KA. 2020. *Laws of the face: Restaging forensic art as a counter-forensic device*. PhD Thesis. Liverpool John Moores University. England.

South African Government. The Inquests Act 58 of 1959 [online]. Available at: https://www.gov.za/sites/default/files/gcis_document/201505/act-58-1959.pdf [Accessed 6 Oct. 2020].

South African Government. Criminal Procedure Act 51 of 1977 [online]. Available at: https://www.justice.gov.za/legislation/acts/1977-051.pdf [Accessed 13 Oct. 2020].

South African Government. Human Tissue Act 65 of 1983 [online]. Available at: http://www.kznhealth.gov.za/humantissueact.pdf [Accessed 14 Nov. 2020].

South African Government. National Heritage Resources Act 25 of 1999 [online]. Available at: http://www.dac.gov.za/sites/default/files/Legislations%20Files/a25-99.pdf [Accessed 14 Nov. 2020].

South African Government. National Health Act [No. 61 of 2003] [online]. Available at: https://www.gov.za/sites/default/files/gcis_document/201409/a61-03.pdf [Accessed 6 Oct. 2020].

South African Police Service. 2019. Annual Crime Statistics [online]. Available at: https://www.saps.gov.za/services/annual_crime_report2019.pdf [Accessed 14 Nov. 2020].

Spies M, Finaughty D. and Gibbon VE. 2018. Forensic taphonomy: Scavenger-induced scattering patterns in the temperate southwestern Cape, South Africa – a first look. *Forensic Science International* **290**: 29–35,

Spies M, Finaughty D. and Gibbon VE. 2018. Forensic taphonomy: Vertebrate scavenging in the temperate southwestern Cape, South Africa. *Forensic Science International* **290**: 62–69.

Spies M, Finaughty D, Friedling L. and Gibbon VE. 2020. The effect of clothing on decomposition and vertebrate scavengers in cooler months of the temperate southwestern Cape, South Africa. *Forensic Science International* **309**: 110197.

Statistics South Africa. 2015. Crime Statistics Series Volume III [online] Available at: https://www.statssa.gov.za/publications/Report-03-40-01/Report-03-40-012015.pdf [Accessed 14 Nov. 2020].

Statistics South Africa. 2016. Mortality and causes of death in South Africa, 2016: Findings from death notification [online] Available at: http://www.statssa.gov.za/publications/P03093/P030932016.pdf. [Accessed 7 Oct. 2020].

Statistics South Africa. 2018. Crimes against women in South Africa. [online] Available at: http://www.statssa.gov.za/publications/Report-03-40-05/Report-03-40-05June2018.pdf. [Accessed 7 Oct. 2020].

Statistics South Africa. 2018. Mid-year population estimates. [online] Available at: http://www.statssa.gov.za/publications/P0302/P03022019.pdf [Accessed 7 Oct. 2020].

Steyn M, Meiring JH and Nienaber WC. 1997. Forensic anthropology in South Africa: A profile of cases from 1993 to 1995 at the Department of Anatomy, University of Pretoria. *South African Journal of Ethnology* **20**(1): 23–26.

Steyn M, L'Abbé EN. and Myburgh J. 2016. Forensic anthropology as practiced in South Africa. In: Blau, S and Ubelaker, DH. (eds.) *Handbook of Forensic Anthropology and Archaeology* Routledge, London. pp. 151–164.

Stull K, Kenyhercz M. and L'Abbé E. 2014. Ancestry estimation in South Africa using craniometrics and geometric morphometrics. *Forensic Science International* **245**: 206.e1-206.e7.

Suchey J. and Brooks S. 1990. Skeletal age determination based on the os pubis: A comparison of the Acsádi-Nemeskéri and Suchey-Brooks methods. *Human Evolution* **5**(3): 227-238.

Sutherland A, Myburgh J, Steyn M. and Becker P. 2013. The effect of body size on the rate of decomposition in a temperate region of South Africa. *Forensic Science International* **231**(1-3): 257-262.

Symes SA, Dirkmaat DC, Ousley S, Chapman E. and Cabo L. 2012. *Recovery and interpretation of burned human remains*. United States of America Department of Justice.

Taylor J, Boisvert D, Sims B. and Garver C. 2012. An examination of gender and age in print media accounts of child abductions. *Criminal Justice Studies* **26**(2): 151-167.

Thomas R, Parks C. and Richard A. 2016. Accuracy rates of sex estimation by forensic anthropologists through comparison with DNA typing results in forensic casework. *Journal of Forensic Sciences* **61**(5): 1307-1310.

Thomas R, Parks C. and Richard A. 2017. Accuracy rates of ancestry estimation by forensic anthropologists using identified forensic cases. *Journal of Forensic Sciences* **62**(4): 971-974.

Truth and Reconciliation Commission Report. 2003. Truth and Reconciliation Commission Report of Human Rights Violations Committee Abductions, Disappearances and Missing Persons. [online] Available at: http://sabctrc.saha.org.za/originals/finalreport/volume6/volume6section4.pdf [Accessed 7 Oct. 2020].

Tyers CA. 2009. *Hidden atrocities: The forensic investigation and prosecution of genocide*. PhD Thesis. University of Tennessee. United States of America.

Tyson PD. And Preston-Whyte RA. 2000. *The Weather And Climate of Southern Africa*. Oxford University Press. Cape Town

Ubelaker DH. *Human Skeletal Remains*. 1989. Taraxxacum Press. Washington, DC.

Ubelaker DH. 2008. Issues in the global applications of methodology in forensic anthropology. *Journal of Forensic Sciences* **53**(3): 606-607.

Ubelaker DH. 2018. A history of forensic anthropology. *American Journal of Physical Anthropology* **165**: 915–923.

Ueland M, Forbes S. and Stuart B. 2019. Understanding clothed buried remains: The analysis of decomposition fluids and their influence on clothing in model burial environments. *Forensic Science, Medicine and Pathology* **15**(1): 3-12.

Vaz M. and Benfica F. 2008. The experience of the forensic anthropology service of the medical examiner's office in Porto Alegre, Brazil. *Forensic Science International* **179**(2-3): e45-e49.

Venter Z. 2018. Without an ID, you are no one in your own country. [online] Available at: https://www.iol.co.za/news/opinion/without-an-id-you-are-no-one-in-your-own-country-16779617 [Accessed 8 Oct. 2020].

Walls R, Olivier G. and Eksteen R. 2017. Informal settlement fires in South Africa: Fire engineering overview and full-scale tests on "shacks". *Fire Safety Journal* **91**: 997-1006.

Western Cape Government. 2014. Forensic Pathology Service (Department of Health, Western Cape Government): Our facilities. [online] Available at: https://www.westerncape.gov.za/general-publication/our-facilities [Accessed 13 Oct. 2020].

Western Cape Government. 2017. Western Cape Provincial Crime Report 2016/17: Analysis of crime based on the crime statistics issued by the South Africa Police Service on 24 October 2017. [online] Available at: https://www.westerncape.gov.za/assets/crime_analysis_western_cape_2016-17.pdf [Accessed 7 Oct. 2020].

Western Cape Government. 2019. Homelessness. [online] Available at: https://www.westerncape.gov.za/general-publication/homelessness-0 [Accessed 8 Oct. 2020].

Western Cape Government. 2020. Wildfire season. [online] Available at: https://www.westerncape.gov.za/general-publication/wildfire-season [Accessed 8 Oct. 2020].

Yadav A, Kumar A, Swain R. and Gupta S. 2016. Five-year study of unidentified/unclaimed and unknown deaths brought for medicolegal autopsy at Premier Hospital in New Delhi, India. *Medicine, Science and the Law* **57**(1): 33-38.

Zgonjanin D, Antov M, Alghafri R, Petković S, Vuković R, Stojiljković G. and Toljić D. 2017. DNA analysis from human skeletal remains in forensic casework. *Forensic Science International: Genetics Supplement* Series **6**: e342-e345.

APPENDIX A.1

Ethical approval from the Human Research Ethics Committee at University of Cape Town (HREC REF: 263/2019).

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: sumayah.arlefdien@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

07 May 2019

HREC REF: 263/2019

Dr V Gibbon
Department of Human Biology
Level 5, Room 5.14
Anatomy Building-FHS

Dear Dr Gibbon

PROJECT TITLE: IDENTIFICATION OF THE DECEASED: A RETROSPECTIVE REVIEW OF FORENSIC ANTHROPOLOGY CAPE TOWN (MSC CANDIDATE - MS A BALISO)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee (HREC) for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 May 2020.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

We acknowledge that the student: Athi Baliso will also be involved in this study.

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

Signature Removed

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938
NHREC-registration number: REC-210208-007

UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

FHS016: Annual Progress Report / Renewal

HREC office use only (FWA00001637; IRB00001938) **This serves as notification of annual approval, including any documentation described below.**			
☑ Approved	Annual progress report	Approved until/next renewal date	30 · 05 2021
☐ Not approved	See attached comments		
Signature Chairperson of the HREC	Signature Removed	Date Signed	24/3/2020

Comments to PI from the HREC

Principal Investigator to complete the following:

1. Protocol information

Date (when submitting this form)			
HREC REF Number	(HREC REF: 263/2019)	Current Ethics Approval was granted until	30 May 2020
Protocol title	Identification of the deceased: A retrospective review of Forensic Anthropology Cape Town casework		
Protocol number (if applicable)			
Are there any sub-studies linked to this study?	No		
If yes, could you please provide the HREC Ref's for all sub-studies? Note: A separate FHS016 must be submitted for each sub-study.			
Principal Investigator	Associate Professor Victoria Gibbon		
Department / Office Internal Mail Address	victoria.gibbor@uct.ac.za		

1.1 Does this protocol receive US Federal funding?	☐ Yes	☐ ✓No

(Note: Please complete the Closure form (FHS010) if the study is completed within the approval period)

APPENDIX A.2

Ethical approval from the Human Research Ethics Committee at University of Cape Town (HREC: R012/2019).

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: Sumayah.arlefdien@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

25 April 2019

HREC/REF: R012/2019

Ms L Heathfield
Department of Forensic and Toxicology
Entrance 3, level 1
Falmouth Building -FHS

Dear Ms Heathfield

Project Title: Forensic Anthropology Cape Town (FACT) database

Thank you for your response letter dated 02 April 2019, addressing the issues raised by the Human Research Ethics Committee (HREC).

The HREC has **approved** the registration of your registry.

The registration of this registry is valid until 30 April 2022.

Please provide the HREC with an update if the registry continues beyond this period.
Please Note: All research, including that undertaken for a master's or doctoral degree, using registered databases, registries and repositories, requires submission as a new study. It requires an application form (FHS013) and a protocol which has undergone departmental review. The study will receive its own HREC REF number which will be linked to the main database or repository.

Please note that any studies using the collected data require separate ethics approval.

Please quote the HREC REF in all your correspondence.

Yours sincerely

Signature Removed

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

HRE/REF:R012/2019

APPENDIX B

FACT has a database containing all relevant information regarding the cases they have worked on. Information in the database includes:

- the FPS facility and forensic pathologists that consulted FACT,
- the CAS and WC numbers, names and contact details of the investigating police officer,
- the FACT members involved in the case,
- date FACT received the evidence,
- the police station, site of discovery and methods of disposal,
- date of discovery of the body,
- the date FACT completed the examination and forensic affidavits,
- the associated physical evidence recovered with the bodies (clothing, associated physical evidence and entomological evidence)
- the presence or absence of crime scene and examination photos,
- the biological profile of each decedent (sex, age-at-death, ancestry and stature),
- the conditions of the remains (taphonomy, degree of completeness and fragmentation),
- the taphonomy of the remains and geographical details of where they were recovered.

APPENDIX C

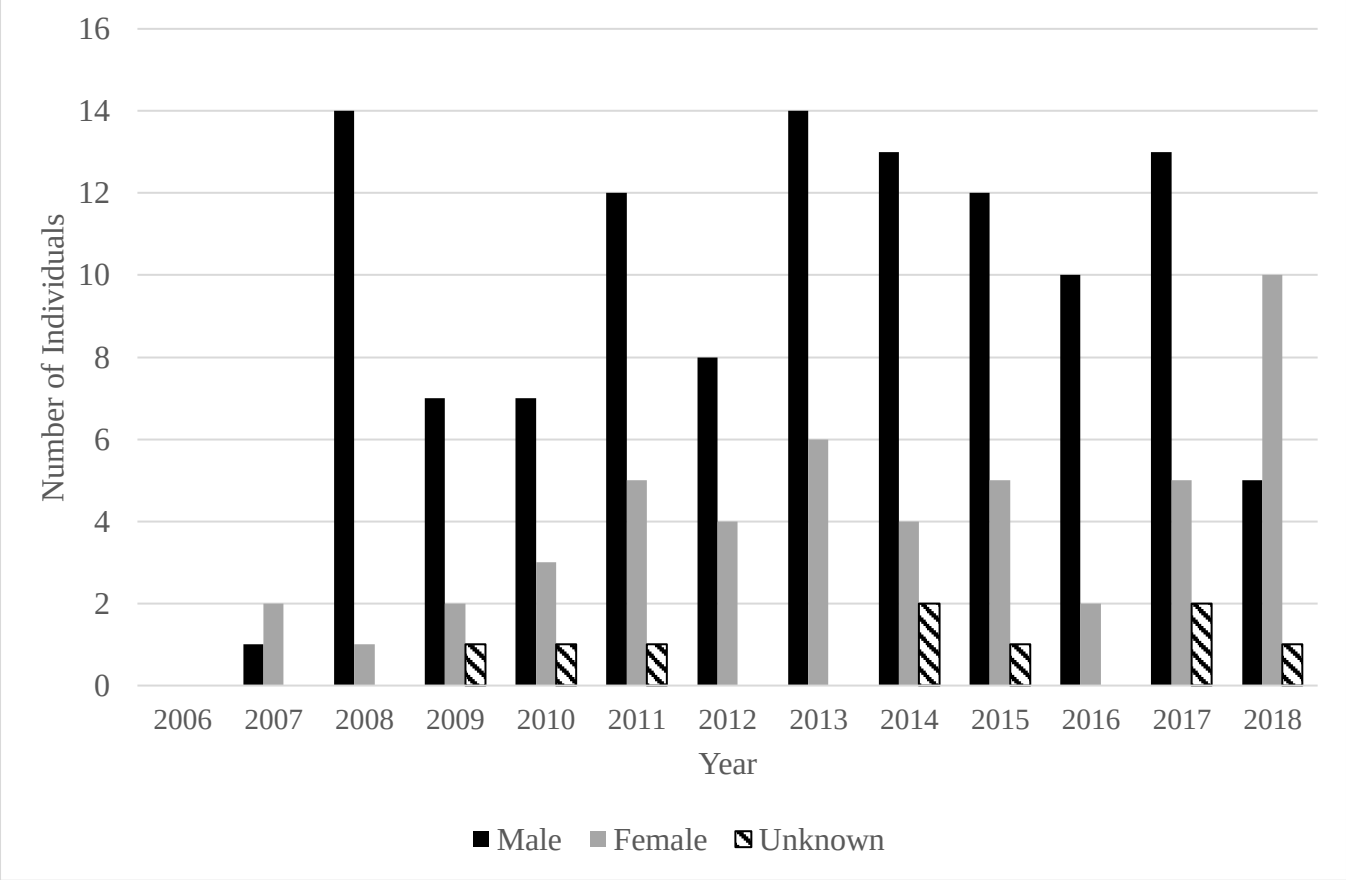

Figure C.1 Distribution of individuals examined at the Forensic Anthropology Cape Town laboratory by sex per year.

Table C.1 Sexual composition of individuals examined by the Forensic Anthropology Cape Town laboratory by age-group.

Age-at-death	**Sex**			**Total**
	Female	Male	Unknown	
Infant	1	1	2	**4**
Child	4	0	4	**8**
Adolescent	2	6	1	**9**
Adolescent-Young Adult	1	0	0	**1**
Young Adult	12	15	0	**27**
Young-Middle Adult	9	11	0	**20**
Middle Adult	8	23	0	**31**
Middle-Old Adult	4	23	1	**28**
Old Adult	6	26	0	**32**
Adult	1	11	0	**12**
Undetermined	1	0	1	**2**
Total	**49**	**116**	**9**	**174**

Table C.2 Sexual composition of individuals examined by the Forensic Anthropology Cape Town laboratory by ancestral-group.

Ancestry	**Sex**			**Total**
	Female	Male	Unknown	
African	14	25	0	**39**
European	0	6	0	**6**
Mixed	19	45	1	**65**
Multiple	6	14	0	**20**
Undetermined	10	26	8	**44**
Total	**49**	**116**	**9**	**174**

Table C.3 Logistic regression of the association between reported demographics (*i.e.* sex, age-at-death and ancestry) with trauma and pathological conditions.

	Ante-mortem Trauma		Peri-mortem Trauma		Pathological Conditions	
	Unadjusted Demographic Association	Adjusted Demographic Association	Unadjusted Demographic Association	Adjusted Demographic Association	Unadjusted Demographic Association	Adjusted Demographic Association
Predictors	eβ (Odds Ratio) [95% CI]	eβ (Odds Ratio) [95% CI]	eβ (Odds Ratio) [95% CI]	eβ (Odds Ratio) [95% CI]	eβ (Odds Ratio) [95% CI]	eβ (Odds Ratio) [95% CI]
Sex	4.04* [1.75 – 9.35]	3.04* [1.20 – 7.72]	1.239 [.528 – 2.907]	1.540 [.594 – 3.990]	2.625* [1.118 – 6.161]	1.684 [.614 – 4.619]
Age-at-death						
Juvenile	.000 [.000 – .]	5.14E-10 [.000 - .]	2.171 [.561 – 8.408]	2.817 [.630 – 12.582]	.043* **(23)** [.009 – .197]	.056* **(18)** [.011 – .280.]
Young Adults	.233* (**4**) [.084 – .649]	.334* **(3)** [.113 – .988]	2.631 [.946 – 7.315]	3.801* [1.213 – 11.911]	.075* **(13)** [.022 – .256]	.090* **(11)** [.024 – .328]
Adult	.250* **(4)** [.089 – .701]	.288* **(3)** [.097 – .854]	2.850* [1.013 – 8.020]	2.751 [.902 – 8.389]	.149* **(7)** [.041 – .539]	.162* **(6)** [.043 – .606]
Ancestry						
African	.409* **(2)** [.180 – .929]	.551 **(1.81)** [.219 – 1.39]	3.031* [1.260 – 7.296]	2.576* [1.023 – 6.486]	.417 **(2)** [.160 – 1.086]	.621 **(1.61)** [.208 – 1.848]
Mixed or African	.398 **(3)** [.131 – 1.12]	.534 **(1.87)** [.144 – 1.98]	.841 **(1.19)** [.210 – 3.367]	.602 **(1.66)** [.139 – 2.597]	.265* **(4)** [.081 – .859]	.440 **(2)** [.107 – 1.805]
European	3.694 [.403 – 33.05]	2.15 [.218 – 21.19]	7.846* [1.293– 47.624]	9.543* [1.478 – 61.622]	.936 **(1.03)** [.098 – 8.790]	.385 **(3)** [.033 – 4.518]

The reference category for sex was female; middle – old-aged adults for age-at-death; and Mixed ancestry for ancestry. The bolded values in the brackets represent the inverse of the odds ratios (1 / Odds Ratio), *i.e.* the odds of the ratio of the reference category relative to the other categories. The * indicates significant odds ratios. CI = Confidence intervals.